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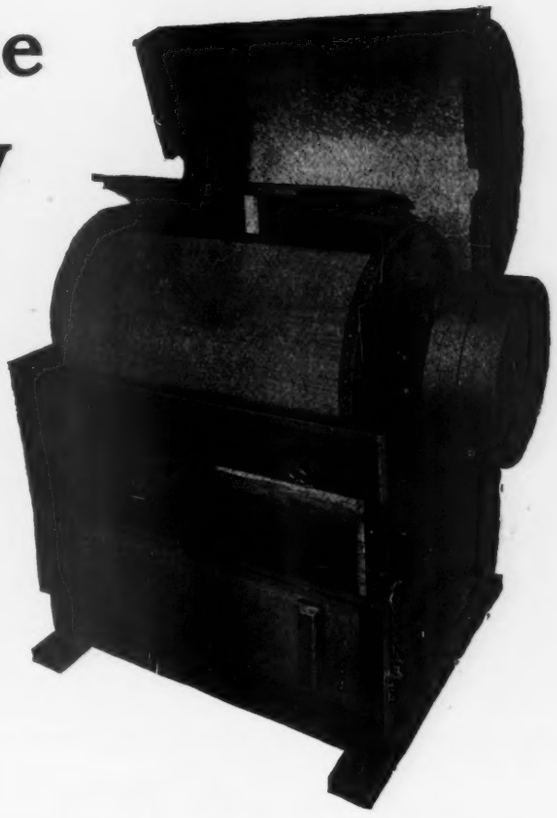

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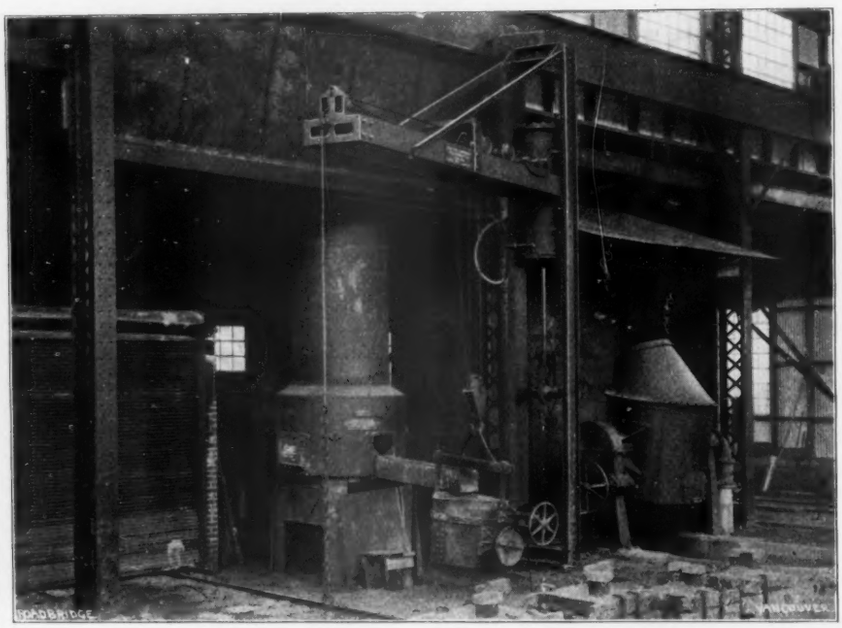

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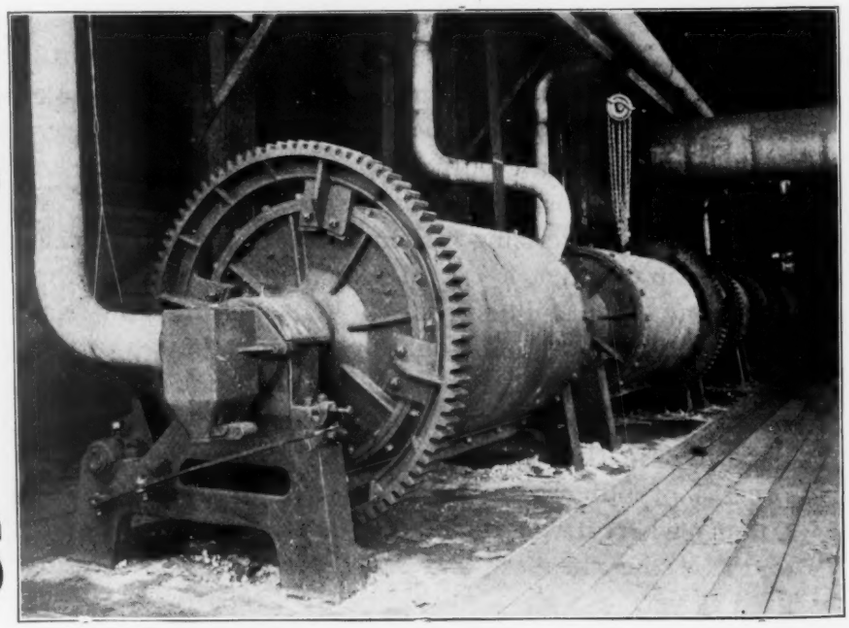

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See other adv. Page 105

THE FOUNDRY

Vol. 38, No. 1 Cleveland, Ohio, March, 1911 Whole No. 223

A CONTINUOUS MALLEABLE FOUNDRY

A modern plant for the manufacture of malleable pipe fittings, recently erected by the Crane Co. --- Continuous molding and coremaking

AMONG the many uses which have been found for malleable cast iron, its general adoption for pipe fittings has necessitated the development of production systems of great ingenuity. The early methods of manufacturing malleable fittings were crude and simple in the extreme, the practice being no different in this line from other work involving a moderate amount of repetition. But as the practicability of malleable fittings and their superiority over ordinary gray iron castings became more widely appreciated, their consumption increased enormously, making it necessary to produce unprecedented quantities at a decreasing cost. Gradually the shops devoted to the manufacture of this product came to have equipment and methods radically different from those found in ordinary foundries. The large quantities of duplicate parts produced made it possible to adopt continuous mechanical systems of molding, pouring, coremaking, etc., which have become distinguishing features. Among those who have brought the manufacture of malleable pipe fittings up to its present state of perfection, the Crane Co., Chicago, stands pre-eminent. For this class of work a new foundry has recently been built by this concern, which embodies the results of over 50 years continuous manufacturing experience and on account of

FIG. 1—DEPARTMENT IN WHICH THE CASTINGS ARE SHAKEN-OUT. THIS SHOWS THE MOLD CONVEYORS, THE GRATING INTO WHICH THE SAND IS DUMPED, AND THE CONVEYORS INTO WHICH THE CASTINGS ARE THROWN AND CARRIED TO THE HARD TUMELING MILLS

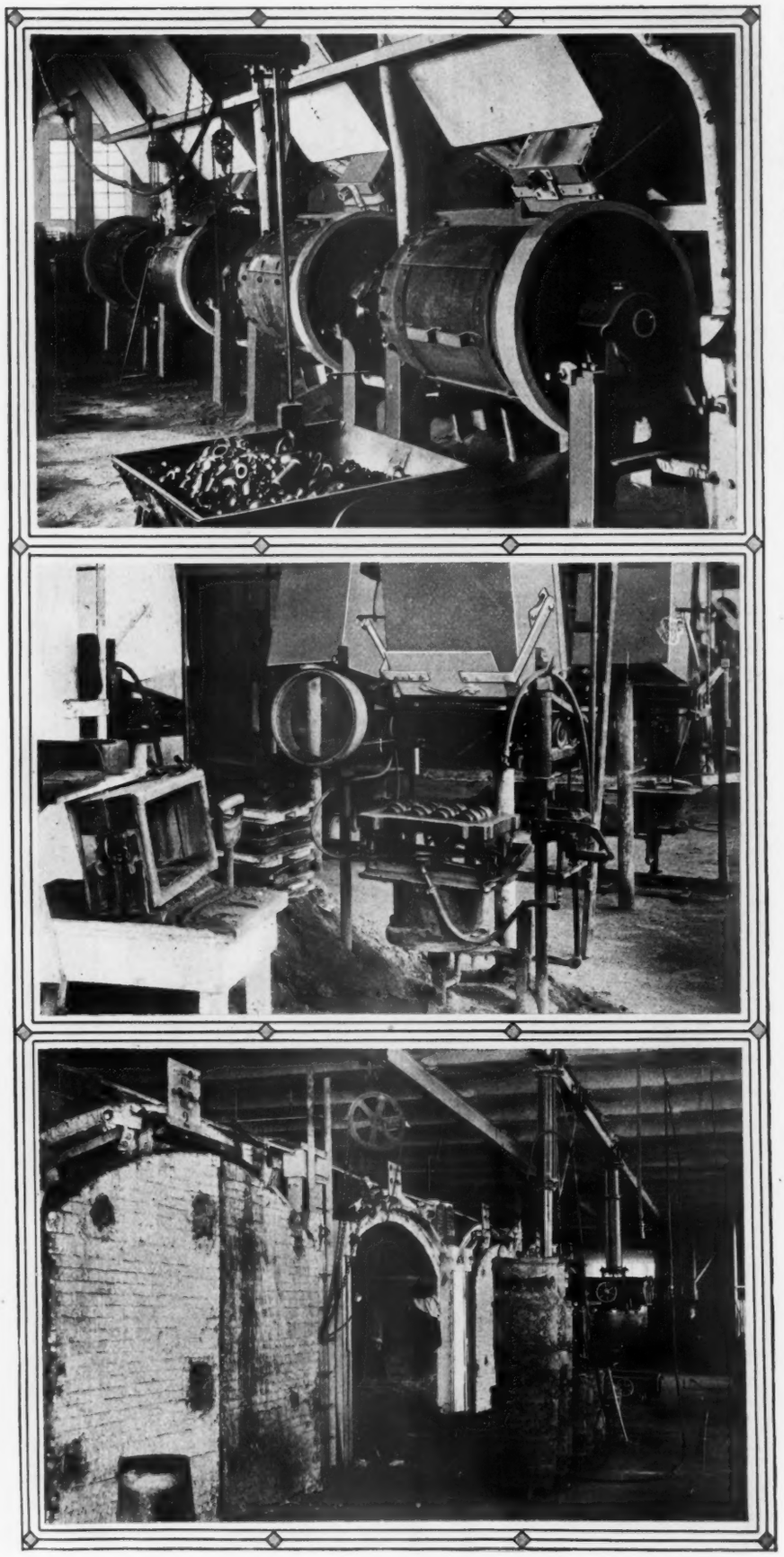


FIG. 2—A ROW OF TUMBLING MILLS, SHOWING THE OVERHEAD BINS TO WHICH THE CASTINGS ARE CONVEYED BY THE ELEVATORS SHOWN IN FIG. 1

FIG. 3—MOLDING MACHINE WITH PATTERN PLATE IN POSITION

FIG. 4—A VIEW OF THE ANNEALING DEPARTMENT, SHOWING AIR HOISTS

its many novel features, this shop is entitled to a position in the first rank among the notable foundries of the world.

A description of the new Crane malleable foundry should prove of particular interest to foundrymen generally, because of the large possibilities in the methods of production in use in this shop. The principles of continuous molding, pouring and coremaking which have been so successfully worked out in detail by this company in its line of work, could be applied with efficiency and economy in many gray iron and steel foundries producing large quantities of duplicate castings of moderate weight, as well as in malleable plants.

The originality of the Crane Co.'s methods is well demonstrated by the fact that the majority of the foundry equipment could not be purchased in the open market, but had to be designed and built to meet the special requirements by the company's engineers. This applies to the sand tempering and handling apparatus, continuous mold conveyors, core and annealing ovens.

The Plant.

The building in which the malleable department is located, Fig. 17, is a steel frame and reinforced concrete structure, absolutely fireproof, provided with brick curtain walls and abundant window area. The structure is five stories in height with a basement and is situated at the southeast corner of South Canal and Fifteenth streets, having a frontage of 177 feet on Canal street and 225 feet on Fifteenth street. The new plant was erected to provide for increased output and more economical methods of production and also as a protection against fire. As has been stated, much of the machinery is of special design and the loss through fire would be exceedingly heavy, to say nothing of the attendant loss of sales due to curtailed output.

Location of Foundry.

Following a plan adopted 45 years ago by the Crane Co., the foundry departments are placed on the upper floors, in this case occupying the third, fourth and fifth. Raw material and supplies for the foundry arrive at the plant in railroad cars and are stored in the basement, from which they are taken as needed to the proper floors by elevators. The molding, casting and galvanizing departments are on the fifth floor and the cleaning, sorting and annealing rooms are on the fourth floor. The core department occupies the third floor; the second is devoted to ma-

chine work, while the storing and shipping departments are on the street floor.

Machine Molding.

The molding floor is divided into six departments, four being devoted to continuous machine molding, one to floor work and one to jobbing or miscellaneous work. The continuous machine floors are of most interest and their general method of operation is as follows:

The sand is prepared, riddled, tempered and conveyed in the proper condition for use to chutes placed directly over each molding machine, as shown in Fig. 3. The molder fits the pattern and flask to the machine, draws the necessary amount of sand from the chute, rams up the mold and places it on the endless conveyor shown in Fig. 1. As the conveyor carries the mold along it is poured, allowed to cool and shaken-out, the empty flask being returned to the molder. The sand from the flasks that are shaken out drops through a grating under the conveyor and is returned to the sand preparing plant to be used again. The castings are shown thrown on the elevators shown in Fig. 1, from which they are dropped into the cleaning mills on the floor below.

Sand Preparing and Conveying Plant.

The sand conveying and preparing plant, which was designed and built by the Crane Co., is elaborate and is shown in some detail in Figs. 5 to 8 and Figs. 14 and 15. From the grating under the mold conveyors at the point where the flasks are shaken-out, the used sand drops onto an endless paddle conveyor, which carries it to the bucket elevator, shown at *A*, Fig. 6. This elevator deposits the sand in hoppers situated over the revolving riddles, *R*, Figs. 5 and 6. The riddles are operated in pairs by electric motors and deposit the sifted sand onto short tempering belts shown at *B*, Fig. 5, which carry it under a fine spray of water from the nozzles shown in front of the riddles. Placed across the belt close to its surface are five curved rods, which riddle the sand as it is being sprayed. The belts, *B*, deposit the riddled and moistened sand on agitators situated under the grating, *G*. The necessary amount of new molding sand is added by dropping it through this grating onto the agitator, where it is thoroughly mixed with the old sand. By this method no more new sand is added than is absolutely necessary and there is no waste. From the agitators, the sand is carried by the long tempering belts, shown in Fig. 7, to the secondary agitator and mixer

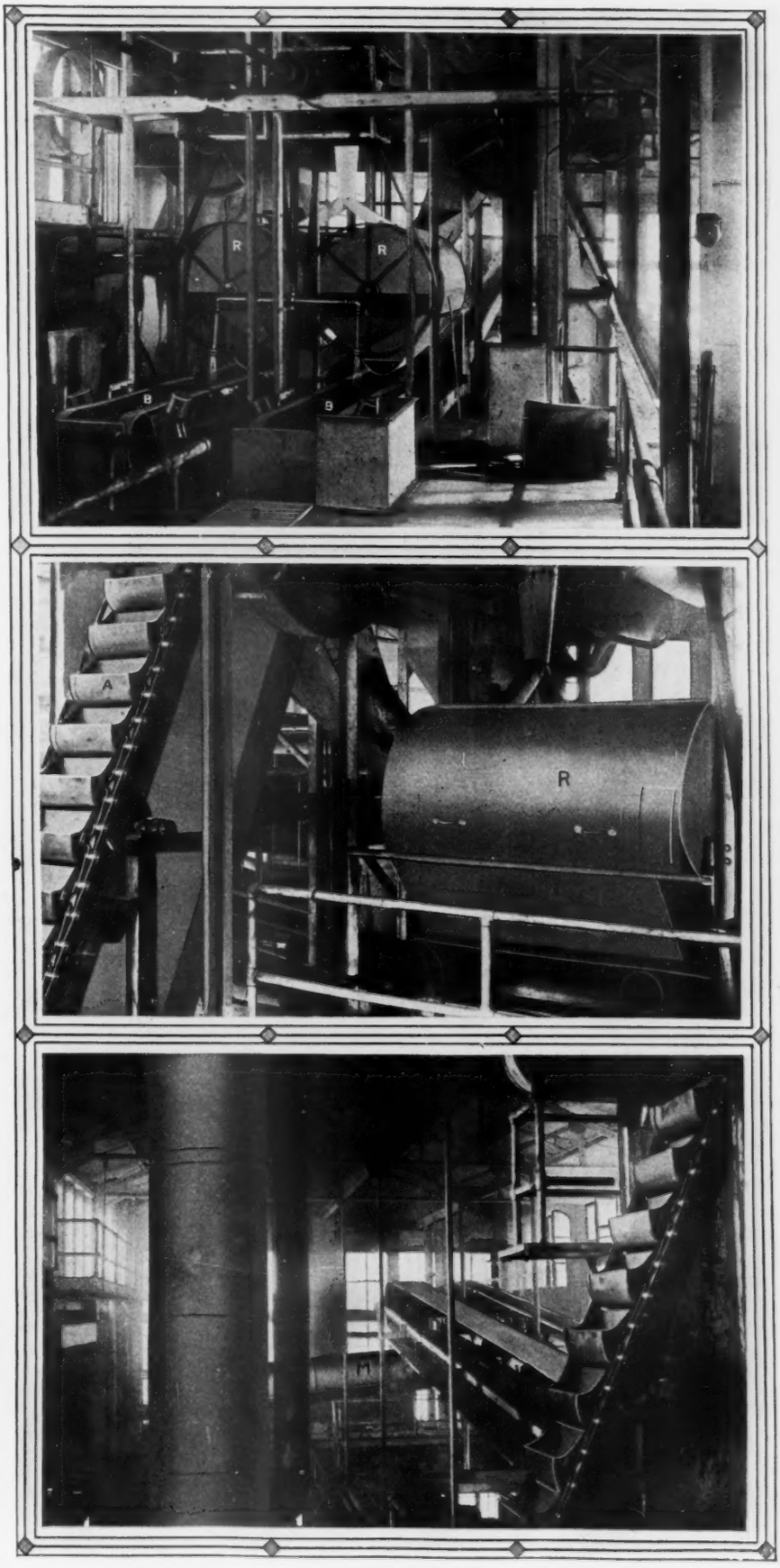


FIG. 5—VIEW OF THE REVOLVING RIDDLE WHICH DISCHARGES THE SAND INTO BELT CONVEYORS

FIG. 6—ONE OF THE BUCKET SAND ELEVATORS IS SHOWN AT *A*, AND A SIDE VIEW OF THE RIDDLE AT *R*

FIG. 7—THE BUCKET SAND ELEVATOR IS SHOWN IN THE FOREGROUND AND THE SAND-TEMPERING BELTS ARE SHOWN IN THE BACKGROUND

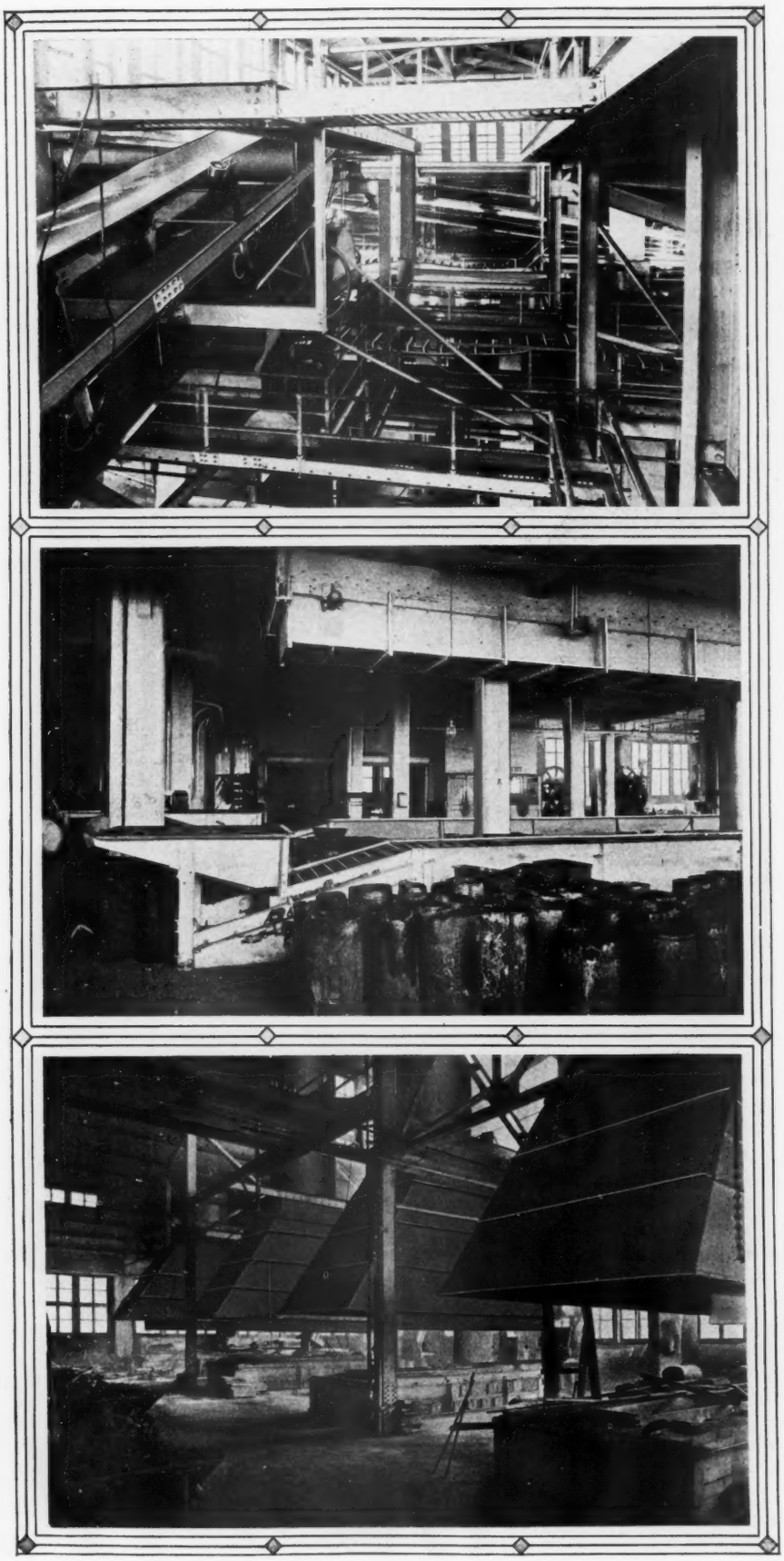


FIG. 8—GENERAL VIEW OF THE UPPER PART OF THE FOUNDRY, SHOWING THE ARRANGEMENT OF THE SAND CONVEYING APPARATUS

FIG. 9—THE DEPARTMENT IN WHICH THE CASTINGS ARE ASSORTED, SHOWING THE CONVEYORS

FIG. 10—A VIEW OF THE GALVANIZING DEPARTMENT

shown at *M*, in this illustration. From this machine the sand, now fully prepared, is carried by a cross conveyor to the distributing conveyors in Figs. 14 and 15. Underneath these conveyors are the steel plate sand chutes, which are situated over each molding machine. The cross and distributing conveyors are of the paddle type and their construction is clearly shown in Fig. 15. The paddle edges are tipped with sectional steel plates to resist the abrasive action of the sand. Slits are cut in the bottom of the conveyor trough over each bin, permitting the sand to drop through; they are not cut parallel to the paddles, as might be expected, but diagonally so they lie across the trough at a 45-degree angle in order that the paddles may pass over smoothly and the sand be properly distributed in each bin. The various sand conveyors are operated by individual electric motors, either direct-connected or belted.

Molding Machines.

On each of the continuous floors there are 26 molding machines similar to those shown in Fig. 3. They are arranged, as indicated in the illustration, in two parallel rows and the continuous mold conveyor shown in Fig. 1, passes within easy reach of each machine. The machines, which were designed by the Crane Co., are of the vibrator type, operated by compressed air. At the left of Fig. 3 one of the iron-bound flasks used in this department may be seen and the pattern plate is in place on the nearest machine. Practically all pipe fittings are symmetrical and therefore both the cope and drag may be molded from the same half pattern. Fig. 3 shows how well the convenience of the molder has been anticipated.

Division of Labor.

The system employed provides, of course, for the division of labor as far as such is economical and the molder confines his efforts strictly to molding, pouring-off being done by another gang. As a result of this arrangement, the molder is a better workman, more skilled and able to earn higher wages. The molder's interest in a mold ceases when he places it on the conveyor; a special gang of men pour it and another gang shake it out.

The molders are paid on a straight piecework basis, and a simple system has been devised to keep an accurate record of each man's work for the day. As has been previously noted, each machine is numbered and is provided with its quota of flasks stamped with the same number, so that as a mold

journeys on its way about the shop on the conveyor, its origin may be easily determined. Each man is provided with a number of brass checks bearing the machine number, and when he places a mold on the conveyor he removes a check from the hook and lays it on the flask. A little further on, before the molds are poured, the checks are collected by a boy and hung on the proper hook on the tally board in front of which the boy sits. From the tally board a sheet is made up showing the number of boxes put up by each man. The molders, of course, keep a separate record by subtracting the number of checks remaining at the close of the day from the number on hand in the morning, and the records of the molders and tally boy must agree; if a discrepancy is discovered it is adjusted by the proper authority. Mistakes are rare, and the records almost always check, although, occasionally, the boy will place a check on the wrong hook on the tally board or the molder will make an error in counting or subtracting.

Mold Conveyor.

The construction of the mold conveyor is clearly shown in Fig. 1. It consists of an endless chain, *C*, of special design to which are fastened trolleys, *T*, in pairs. From each pair of trolleys a carrier is suspended holding four molds.

The pouring is done from small trolley ladles, Fig. 16, each being in charge of one man. The cupola, 68 inches in diameter, designed and built by the Crane Co., is centrally located with respect to the various floors and is operated continuously. From the cupola, the rails for the trolley ladles lead to the pouring stations and back in the form of a loop, several ladles being operated on each loop, carrying hot metal to the molds continuously.

After the molds have been poured and have traversed a sufficient distance to cool they reach the point shown in Fig. 1. Here the flasks are shaken out; the sand is dropped through the grating underneath the conveyor, and the castings are thrown, gates and sprues attached, onto the elevators that discharge into bins over the tumblers. As the castings are thrown onto the elevators they are sorted as to size, one elevator carrying ½-inch fittings, another ¾-inch, etc. This saves much confusion and rehandling in future operations. Hoods are arranged over the discharge ends of the elevators to carry away the dust and smoke.

On the fourth floor, below the points where the molds are shaken out, are

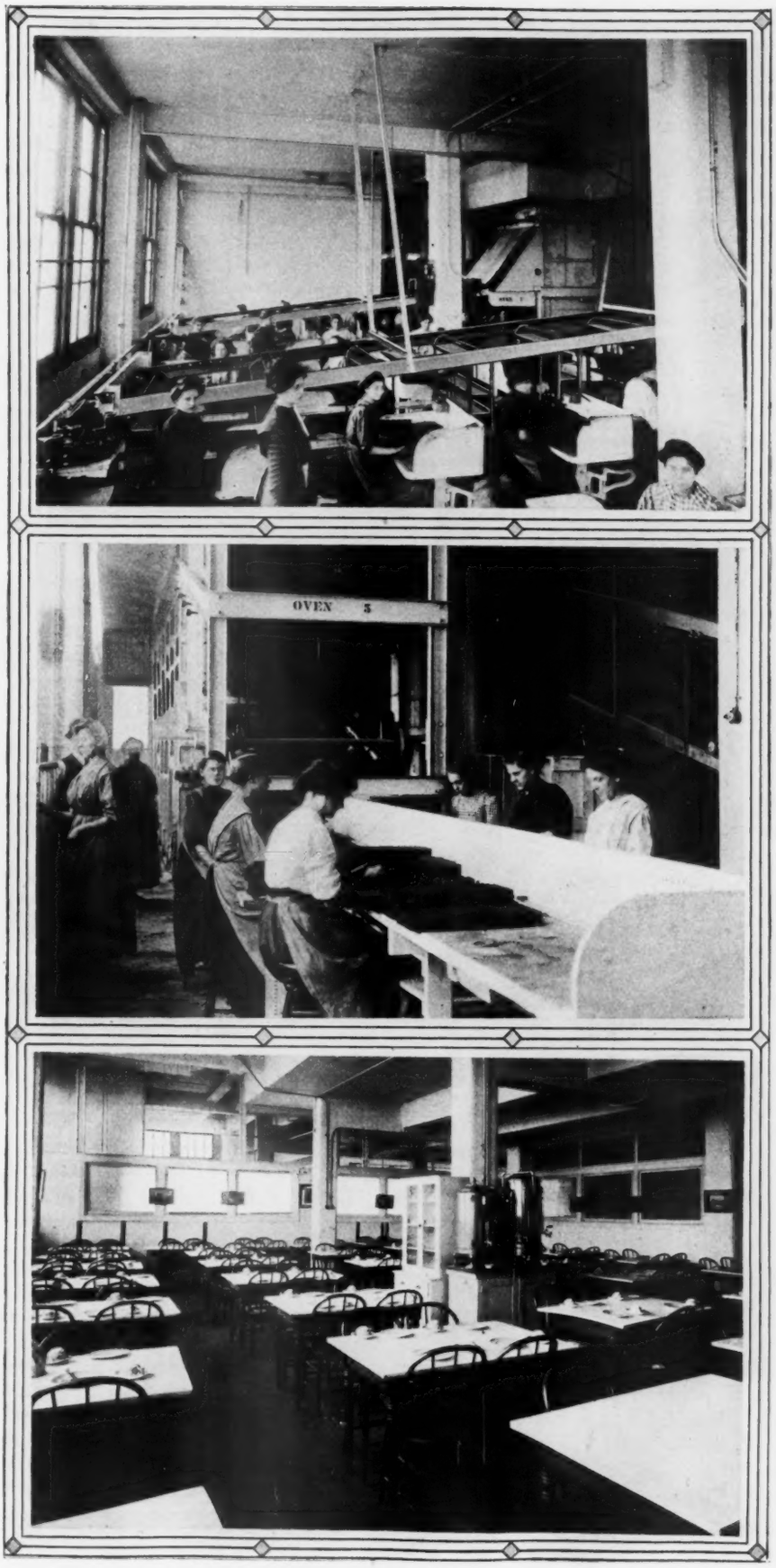


FIG. 11—COREMAKING DEPARTMENT, SHOWING ONE OF THE CONTINUOUS CORE OVENS IN THE BACKGROUND. TWO OF THE CONVEYORS WHICH CARRY THE CORES ON TRAYS THROUGH THE OVENS ARE CLEARLY ILLUSTRATED

FIG. 12—THE DISCHARGE END OF ONE OF THE CONTINUOUS CORE OVENS

FIG. 13—LUNCH ROOM FOR THE WOMEN EMPLOYES OF THE CORE DEPARTMENT

batteries of tumblers, Fig. 2, used to clean the castings. The tumblers are electrically-operated on the group system. After cleaning, the castings are carried in a bucket handled by an air lift to the sorting tables, where the bad castings, gates and sprues are removed. Fig. 2 also shows the small chain hoists, suspended on trolleys, used to remove the covers from the tumbling mills and this is a fair illustration of the great detail in which the governing principle of saving human effort has been developed in this plant.

Core Department.

The core department on the third floor is an especially interesting feature of the plant and in this department we find the principle of continuous production worked out with the same care as in the making of castings. The vast quantities of duplicate cores produced, makes it possible to employ novel and economical methods and due advantage is taken of this possibility. Seven continuous, oil-fired core ovens are installed, and the method of operation is as follows:

The coremaker's benches are arranged in rows on either side of the endless conveyor which passes through the oven. The conveyor consists simply of two chains between which racks are suspended, the chains being about 4 feet apart with one rack for each 3 feet of conveyor, approximately. The conveyor moves at a speed of about 6 inches per minute and since the ovens are 30 feet in length each core is 60 minutes in passing through. As soon as the coremaker finishes a tray of cores, without leaving her seat, she places it on the rack that happens to be passing her bench at the time and returns to her work. Women are employed in this department and they soon become very skillful, rapid workers. At the discharge end of the oven, Fig. 12, the racks and baked cores are first cooled by passing through the air for several minutes, the conveyor at this point moving vertically and the cores are then transferred to the discharge benches, where they are inspected, scraped and sorted. Vertical conveyors carry the finished cores from the third floor to the molding room on the fifth.

Twelve annealing ovens, Fig. 4, are installed on the fourth floor, the frame of the building at this point being extra heavy to carry the weight. The ovens are arranged in two rows back to back. Oil is used for fuel. The design of the ovens is exceedingly simple and instead of the maze of flues not uncommon in the walls of such structures there are only three oil burners centrally located in the roof and four take off flues in the floor, one in each corner. Round pots are used piled one on the other with the joints sealed as shown in Fig. 4. The castings are placed in the pots without iron ore, mill scale or other packing. In Fig. 4 may be seen the air hoist trolleys used for handling the castings to and from the sorting tables.

Assorting Department.

After annealing and cleaning, the castings pass to the assorting tables, Fig. 9, which are merely slow moving flat pan conveyors, where they are sorted out and placed in sheet iron tote drums for distribution to the various machines in the machine room on the second floor. Here they are tapped, threaded and finished. The castings come to the assorting tables in buckets carried by the air lift trolleys shown in Figs. 2 and 4; they are deposited in the shallow receiving hoppers at the end of the tables to the left in Fig. 9.

On the fifth floor is located the galvanizing department, Fig. 10, which is provided with standard equipment. Over each kettle is a large hood communicating directly with the outer air, thus carrying away all the fumes and gases. The galvanizing room is unusually light, airy and agreeable.

A large stock of finished fittings of all sizes is carried on the street floor, which is provided with facilities for shipping either by team or rail. One corner of this floor is partitioned off for the office of the plant.

The foundry supplies are stored in

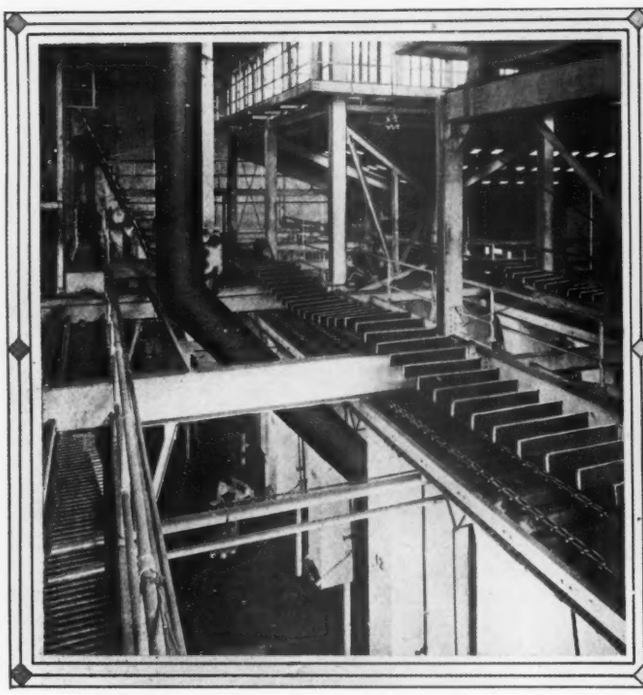


FIG. 14—DISTRIBUTING CONVEYORS WHICH DELIVER THE SAND TO THE MOLDING MACHINE CHUTES SHOWN UNDERNEATH THE CONVEYORS

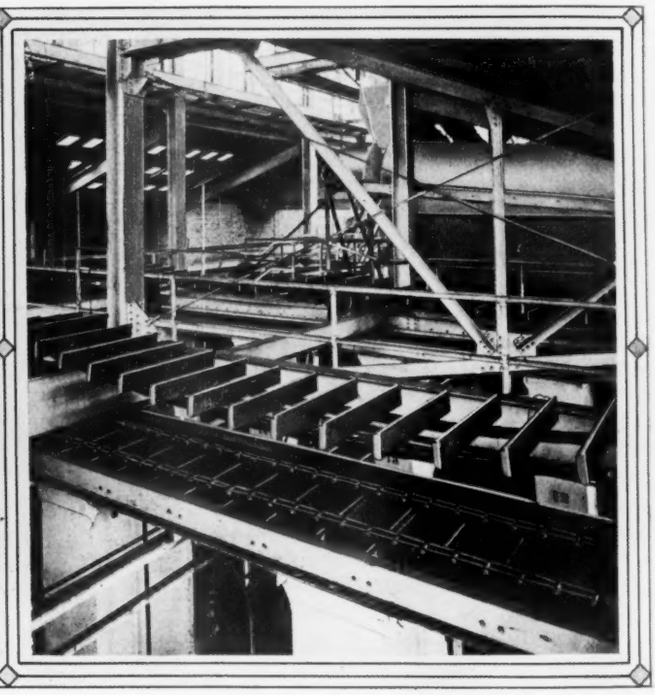


FIG. 15—ANOTHER VIEW OF THE SAND CONVEYORS AND MOLDING MACHINE CHUTES. SAND CHUTES ARE NUMBERED TO CORRESPOND WITH MACHINE NUMBER

the basement, which is equipped with bins and an extensive conveyor system for handling materials. A stock of sand sufficient for six months operations is carried so that it is not necessary to receive shipments of sand during the cold weather, when it is often frozen solid and exceedingly difficult and expensive to handle.

In the design of the plant the welfare of the employes has been given careful consideration. Pains have been taken throughout the building to make it free from dust, smoke, noxious fumes and everything else of a disagreeable nature. Many years ago the Crane Co. introduced the practice of employing women in the coremaking department and every consideration is given their comfort. Dressing rooms and ample toilet facilities are provided and the women are not obliged to work with men, thus relieving them from possible embarrassment. A special dining room, fully equipped as shown in Fig. 13, is also provided for the exclusive use of women employes. To avoid the confusion incident to the dismissal of the employes in a great plant and to permit the women to board homeward cars before they are packed with workingmen, the girls are dismissed for the day some little time before the male employes.

Airy locker rooms and extensive shower baths are provided for the men. Some foundrymen complain that their men do not take advantage of the bathing facilities which are afforded them, but this is not the experience of the Crane Co.

The foundry proper employs about 300 men, and including coremaking, annealing and other departments, the employes of the plant number 1,200 when running full. The rated output is 100 tons per day. The plant was built under the personal supervision of R. T. Crane, president of the Crane Co., to whom we are indebted for the illustrations and data presented herewith.

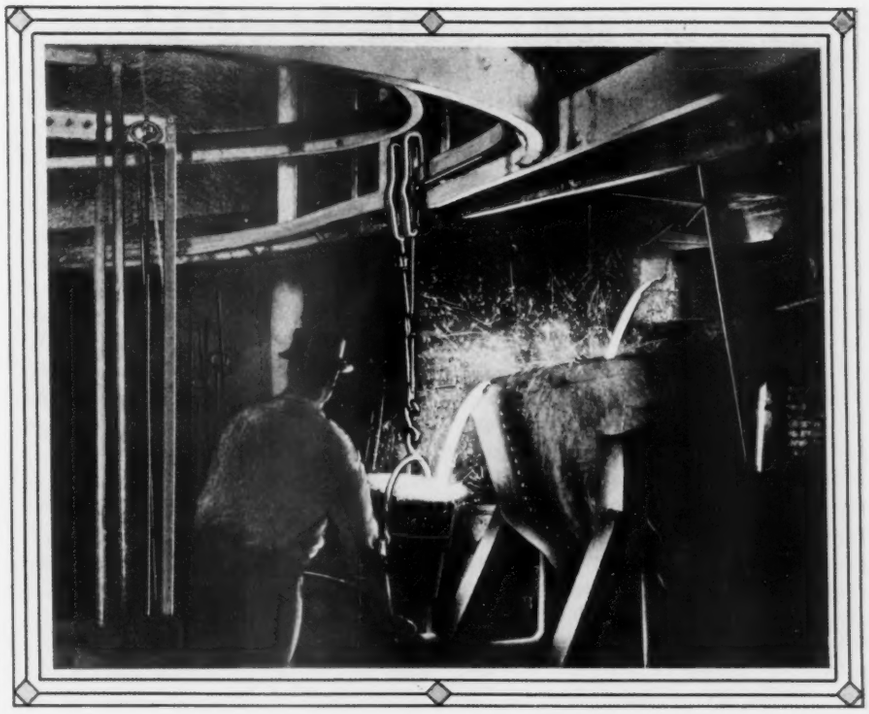


FIG. 16—THE IRON IS TAPPED FROM THE CUPOLA INTO A RECEIVING LADLE, FROM WHICH IT IS POURED INTO SMALLER LADLES SUSPENDED FROM AN OVERHEAD TROLLEY

Hard Iron

By N. W. Shed

Question:—We have a contract for castings ranging from 1 to 1¼ inches in diameter and 5/16 inch in thickness, and would like to have them as hard as possible. We would like to pour them with the same iron used in our other work and would like to add an alloy in the ladle to harden the iron to be used for these molds. Can you advise us what to use?

Answer:—The usual method of hardening a small quantity of iron is to add powdered ferro-manganese, which is sifted onto the iron as it comes from the cupola spout. Less than 10 per cent is usually sufficient. The hardening effect is not great, but it gives a closer grain to the iron. To be sure of a harder mixture, it would be well to add 10 to 20 per cent of car wheels to the charge in the cupola. Sometimes a little sulphur is added in the ladle, but this generally produces white iron, which runs too hard for most purposes. If the silicon is high in your mixture, you might try 1 ounce of sulphur to 40 pounds of iron, and you would thereby get an iron which would be hard and not white. Most foundrymen consider sulphur a curse, but in this case it may prove a blessing.

FIG. 17—A VIEW OF THE CRANE CO.'S NEW MALLEABLE FOUNDRY AT SOUTH CANAL AND FIFTEENTH STREETS, CHICAGO

IMPROVING THE QUALITY OF CAST IRON*

A discussion of the problems of the iron founder with suggestions for improving the quality of his product

ONE of the many problems which confronts the modern iron founder evolves the improvement of the quality of cast iron to an extent sufficient to raise its value and extend its function in the eyes of the mechanical engineer, so that it will not continue to be superseded by other metals and alloys for many important parts of mechanical construction. There are no practical reasons for supposing that cast iron is not able to hold the position it has lost against steel or wrought iron, phosphor bronze or some other costly metal or alloy, providing the founder is able to guarantee a certain tensile strength well within the known compass of cast iron, as the loss of ground is not entirely the result of the establishment of strength or specifications for physical properties that cast iron could not meet, but rather to its being inferior in quality, or defectively manufactured.

As an instance, hydraulic cylinders are made of steel, which might have been constructed of cast iron without an unwieldy section; also, the working and bearing parts of engines, such as slide bars, motion blocks, eccentrics, etc., are made of steel or case-hardened wrought iron, where cast iron of the right hardness, tenacity and density would have been equally, if not more satisfactory. Steel is also used for superheated steam fittings, when careful experimenting has shown that cast iron of the best quality is just as suitable. Improved cast iron, suitable for work of this description, must be superior to ordinary qualities in the following respects: It must have greater tensile strength, a much higher specific weight, and must contain fewer impurities, especially free carbon, which interrupts the crystalline continuity of its structure. It must be more regular in its structure in large masses and more nearly similar in physical character to the metallic condition known as solid solution.

Producing Castings of Uniform Quality.

Ordinary cast iron has a tensile strength of from 18,000 to 21,000 pounds per square inch and especially good iron will have a tensile strength of 27,000 pounds, and the average specific density will be about 7 pounds. If the iron founder can turn out, with certainty, an iron having a constant tensile strength of 33,600 or 35,840 pounds, and a constant specific density of 7.25, he will find he has a material capable of competing with steel in many spheres where that metal now holds the field.

Variation in the Quality of Cast Iron.

The author said he would discuss how such an iron can be turned out in the foundry. It is not a question of getting these results once, but always, as it is quite common to get an exceptional result occasionally. However, a series of tests nearly always shows a very great variation between the maximum and minimum results in outputs of iron, showing wide ranges of quality which are a particular source of danger to the trade, as they prejudice cast iron, because calculations on an unreliable material can only be based on the strength of the lowest quality. In treating of raw materials, the author expressed his disapproval of the practice of melting pig iron in the cupola, with proportions of cast scrap, steel, or wrought iron, and running it into pigs, which are then remelted for castings, the object being to reduce the silicon and close the grain. Commenting on this, the author said: "The cupola is not in any sense a purifying furnace, so what may be gained by lowering the silicon by remelting, is more than compensated for by increased sulphur, oxidation and other changes, especially the loss of manganese. Therefore, it is better to take pig iron of the silicon and approximate density required, than to take a higher silicon pig than is necessary and melt it down twice. I, therefore, fall back on the old-fashioned system of mixing pig irons and scrap, and will venture to indicate certain principles and methods by which our arrangement of such mixtures should be governed.

"First, regarding the method of mixing or grading on a silicon basis. When, a generation ago, the influence of silicon on the iron carbide system in cast iron was first discovered, it was clearly a most important scientific discovery in connection with the properties of iron. It at once became apparent that the founder had been placed in possession of a secret by which he could much more readily control the hardness and softness of his castings, than by any method previously known. The result was that founders at once chose silicon as the sole basis for adjusting their mixtures and regarded it as the governing element, and this consideration has persisted almost universally, and, to my mind, has brought the trade of iron founding, in its connection with high-grade mechanical construction, almost to the verge of ruin. Silicon, while one of the governing elements, is by no means the only one, and, considering the knowledge that exists today regarding the influence of other elements, the effects of different treatment and temperatures, and the extended understanding of the forms in which carbon may be precipitated in iron, etc., it will be granted that the arrangement of iron mixtures on a silicon basis is absolutely unscientific, and that it would be better to review the effects of the whole of the foreign elements in the iron, and consider how these elements will affect, or be affected, by melting, how they interact, and how their presence or absence in certain quantities, will govern the condition and behavior of the metal when it is tapped and poured. The worst mistake that can be made when making castings of high mechanical quality, is to mix high and low silicon irons. It is against nature that such irons should mix together and to bring up a hard, low silicon iron, with a percentage of soft, high silicon iron, or to let down a soft, high silicon iron, with a percentage of a hard, low silicon iron, is not good practice for the average founder if first class castings are desired.

Uniform Silicon and Carbon Contents.

"The principal elements in cast iron are silicon and carbon, and it will be found that the melting point and specific weight of pig iron are governed chiefly by these, and to get really fine iron, and get it regularly, nothing but irons reasonably alike in their silicon and carbon contents, should be taken, the proportions of which should be similar to what is required in the mix-

*Abstract of a paper presented by J. F. P. Lewis at the Technical College, Glasgow, Scotland.

ture. For strength and density, silicon and carbon should be both low, the hardness being controlled by careful adjustment of the sulphur, manganese and phosphorus, taking into consideration their effect on the final condition of the carbon. The theoretical effect of certain percentages of chemical elements on the finished casting must not only direct the arrangement of the mixture, but also the combined effect of these elements on the physical phenomena of melting and cooling.

Correct Balance Between Silicon and Carbon.

"In the discovery of the correct balance between these two factors, I consider the whole problem of iron founding lies, for if we pursue the chemical theory alone, as applied to cold cast iron, we shall be tempted to take the purest possible pig iron, especially as regards sulphur and phosphorus, so that we may get a casting as nearly approximating steel as possible. While this is an attractive idea it is not easy to carry out in practice, since the metal when melted in the cupola will lack fluidity, through lack of heat, and cannot expel the gases, slags or oxides before solidification, the result being blown or otherwise defective castings. It is useless, therefore, to persist with what may be termed the irreducible-minimum theory of phosphorus and sulphur for ordinary cupola melted metal. It is necessary, in order to obtain a casting free from flaws and having a close and regular molecular structure throughout, to introduce more of those elements into the iron that promote heat and widen the range of fluidity of the metal, and the elements most useful in that direction are manganese and phosphorus, both of which can be raised to an astonishing degree, even when sulphur is already high, without injuring the strength, providing the melting is properly done, and full advantage taken in casting of the liveliness and fluidity of the metal. This is because the final specific density of the casting will be the index of its mechanical and physical qualities, rather than its chemical analysis, within, of course, reasonable limits, and this specific density is more easily achieved with quantities of phosphorus, manganese and sulphur, than with an ideal iron almost free from these elements.

Silicon and Fluidity.

"The question arises, why cannot silicon be used to give fluidity, if the latter is the secret of success, as silicon also produces this result? The writer's practical experience, however, has shown that the fluidity caused by silicon, although very great while it lasts, is narrow in range, and that the solidification of silicon iron is more rapid, once a certain amount of heat is lost than the solidification of phosphoric or manganiferous metal. The best proof of this lies in the well known phenomena called liquid shrinkage in molten iron, which is reduced to a minimum in high silicon mixtures, whereas, all founders are aware of its rapidity and duration in the strong irons, particularly with high manganese. Personally, there is nothing I view with more satisfaction when a mold has been filled with hot metal than the sinking of the head in the dead head and feeders, providing that I am satisfied that the molding sand was refractory and porous, and the mold properly vented. In my practical experience, I have found that it is extremely difficult, if not impossible, to get a tight casting of high specific weight with silicious irons, however fluid, but I find it easy with a low silicon iron fairly high in manganese, sulphur and phosphorus.

High Grade Cast Iron.

"Therefore, in my opinion, to obtain improved castings it is necessary that the iron be low in silicon, and, if possible, low in carbon, but in any case the total carbon of the mixture must be low. It should also be rich in manganese, and fairly so in phosphorus, while the sulphur may stand at a higher figure than is generally considered as the limit by the analyist. The actual mixture from which the best results were obtained, follows: Frodair pig iron, 30 per cent; Bearcliffe pig iron, 20 per cent; cold blast pig iron, 25 per cent; hard selected gray scrap, 25 per cent. These irons are all smelted in England and may be described as follows: Frodair is a dense iron carrying low silicon and very low carbon, but melting hot and fluid by reason of fairly high percentages of phosphorus and manganese, with sulphur about 0.08 per cent. Bearcliffe is a tough iron of the true hematite class, carrying 1 per cent silicon and moderate carbon, low phosphorus and high manganese, with sulphur about 0.12 per cent. The cold blast is a coke iron with the typical cold blast analysis, very low in carbon and silicon, medium phosphorus, sulphur and manganese. The scrap iron was not analyzed, but was judged as being low in silicon, with medium carbon, high sulphur and medium phosphorus and manganese.

"In the mixture 30 per cent of Frodair is taken to make absolutely sure of the heat and fluidity of the metal, and as a really low carbon basis for the specification; 20 per cent Bearcliffe will keep phosphorus within safe limits and will help fluidity by reason of its manganese, while 25 per cent of cold blast is added to restore the carbon figure, which has been lowered somewhat by the Bearcliffe, to keep sulphur within reasonable limits and to guard against extreme hardness. These last two irons give most of the strength and toughness to the mixture, the scrap being used as an economy and as much of it might have been taken as the carbon and sulphur specifications would have allowed. All the irons used have about the same silicon, and when mixed in the proportions, castings can be produced which will answer for many of the purposes for which steel is now being used.

"The essential point in melting is to melt rapidly and hot, the great trouble in many foundries being that the cupola does not melt quickly, but falls behind its scheduled capacity, and when this is the case the entire melting equipment should be overhauled, from the motor to the cupola spout. The failure will generally be due to the blast and not to lack of power or pressure, but probably, on the other hand, to too much of these, the loss of blast being due to inadequate tuyerage, resistance at the furnace and in the pipe connections. The remedy is quite simple. Calculating 35,000 cubic feet of air for each ton of iron melted, figure what quantity of air per minute the blower should deliver in accordance with the rated capacity of the cupola, and install a blower that will produce this amount of blast at a velocity which is judged necessary to convey it freely to the furnace, presuming that the pipes, wind box and tuyeres are of ample area. The velocity of the blast will vary somewhat with the size of the furnace, that is, the distance the air has to travel through the fuel.

The Blast.

"The flow of air under pressure is not as well understood in the foundry as it should be, and many foremen would be surprised to know what vast quantities of air will flow at high velocity through 10-inch, unobstructed pipes under a few ounces of pressure. The pressure gage should be attached to the blast pipe, where it joins the fan casing. It then indicates the amount of air the fan is giving, because a given velocity is the result of a given pressure, and the volume is according to the velocity when the

area of the pipe is known. A certain amount of loss will occur through friction in the pipe and connections, which will be greatly increased by angles and bends. Therefore, it is better to eliminate such angles, whenever possible, as the friction in a straight pipe can be more easily estimated and allowed for, the idea being for the blower to deliver the proper amount of air, which should be allowed to pass freely to the cupola. For this reason the tuyere area should be two or three times as great as the area of the blower outlet.

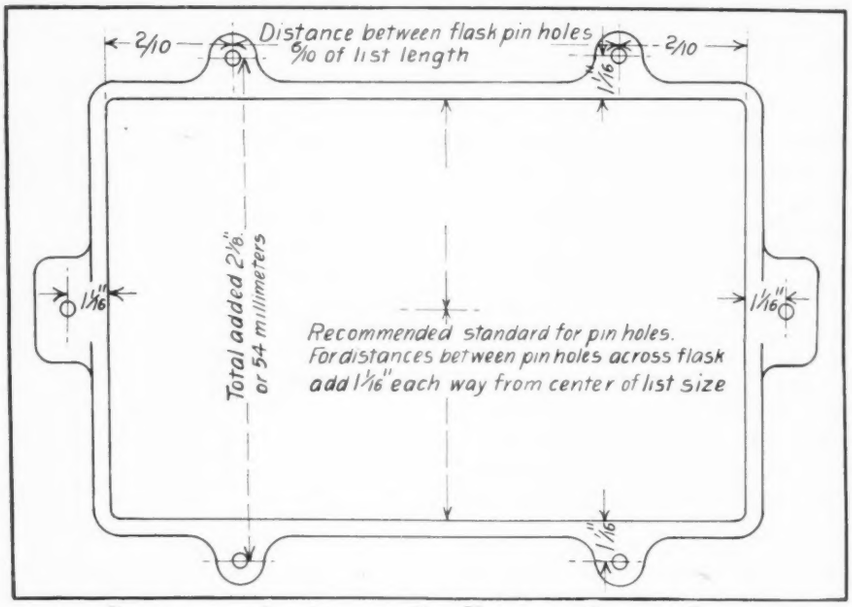
"Experience has taught the writer that the hotter the iron is cast, the better will the casting be, as regards density and strength, as the increased fluidity permits a more complete expulsion of gases and the hotter the iron is poured the more rapid the cooling process, that is, the temperature will come down over a wider range in the same time. Therefore, the time for oxidation and other reactions is correspondingly reduced. I do not believe any temperature produced by the cupola warrants delay in pouring the iron, but of course it is understood that the hotter the metal is cast, the greater the care and the wider the scope in venting the mold, the more resistant and refractory the sand and the more ample and skillfully disposed must be the provisions for feeding."

Frederic B. Stevens, Detroit, manufacturer of foundry supplies and equipment, has furnished the Quality Beds, Ltd., Welland, Ont., with a Colliau cupola.

Standardized Flasks

By J. H. Wood

The majority of manufacturers of metal goods do not operate their own foundries, but purchase their castings from outside shops. As match-plates are used extensively, these must be fitted to the flasks of the foundry in which they are to be used, and this, therefore, practically confines the match-plate work to one foundry, as the plates would have to be altered if sent to another shop. This is due to the fact that the location of the pins of the flasks in no two foundries is exactly alike. To some extent, this has restricted the use of match-plates. A remedy for this would be the standardization of all cast iron flasks with the pins arbitrarily centered, and the method of accomplishing this is shown in the accompanying illustration. For instance, the distance between the pin holes on the sides of the plates and flasks should be six-tenths of the length of the flask or plate at the parting line. The location of the pin holes outside of the parting line, always using catalog sizes, should be 1 1/16 inches, which is equivalent to 27 millimeters, thereby requiring no change in case of the adoption of the metric system.



RECOMMENDED STANDARD FOR PIN HOLES FOR FOUNDRY FLASKS AND MATCH-PLATES

Castings for Safes

By W. J. Keep

Question:—We would like to begin the manufacture of castings for safes, including door frames, etc., and are particularly anxious to learn how to mold and gate them and would also like to receive details of flask construction, grade of iron to use, etc.

Answer:—Some castings are generally large and are made of tough chilled iron. The chill on all outside surfaces is imparted by casting the material against a cast iron chill. If you could afford to, add 20 per cent of spiegeleisen to increase the manganese to 6 or 7 per cent and at the same time to have the silicon sufficiently high to insure a gray iron except on the chilled surfaces, the gray side of the casting could neither be drilled nor cut. If the castings are comparatively small they can be molded in an ordinary flask. The chills can be set where needed. The gates should be placed at the side farthest from the chill.

Close-Grained Iron

By N. W. Shed

Question:—We are builders of a line of embossing machines used on all classes of paper stock and in connection with the machines furnish a head, which is steam heated, to which the dies for doing this class of work are attached. We have had considerable difficulty in obtaining castings steam tight. The steam heads vary in size, the average being about 26 x 33 inches and 5 inches thick. These castings are machined on all surfaces and for this reason the casting should be of such a degree of hardness that no difficulty will be experienced in the machine shop. We appreciate that it will be necessary to use an iron quite high in manganese, but do not know the limit in this respect. The castings contain cored holes for the steam inlets and outlets, which are 2½ inches in diameter. The castings are subjected to a steam pressure of 90 pounds. We would like to have a mixture which will answer our purpose.

Answer:—This work calls for a close-grained iron of the same quality used for steam cylinder castings. For general work of this kind a low silicon iron, fairly high in manganese, should be used. The pig iron should contain silicon from 1.60 to 1.80 per cent, and by adding car wheel and steel scrap a good, close-grained iron can be obtained. The mixture should be made up as follows: Pig iron, 40 per cent; car wheels, 20 per cent; steel scrap, 10 per cent, and cast iron scrap, 30 per cent. If the charge consists of 4,000 pounds, add 50 pounds of ferro-manganese to each charge. If 20 per cent spiegeleisen is available use 200 pounds to each charge. This should produce gray iron which would give approximately the following analysis: Silicon, 1.40 per cent; sulphur, 0.09 per cent; phosphorus, 0.45 per cent, and manganese, 0.90 per cent.

MOLDING A CYLINDER IN LOAM—I

A detail description of a practical method of molding a low pressure, tandem engine cylinder in loam

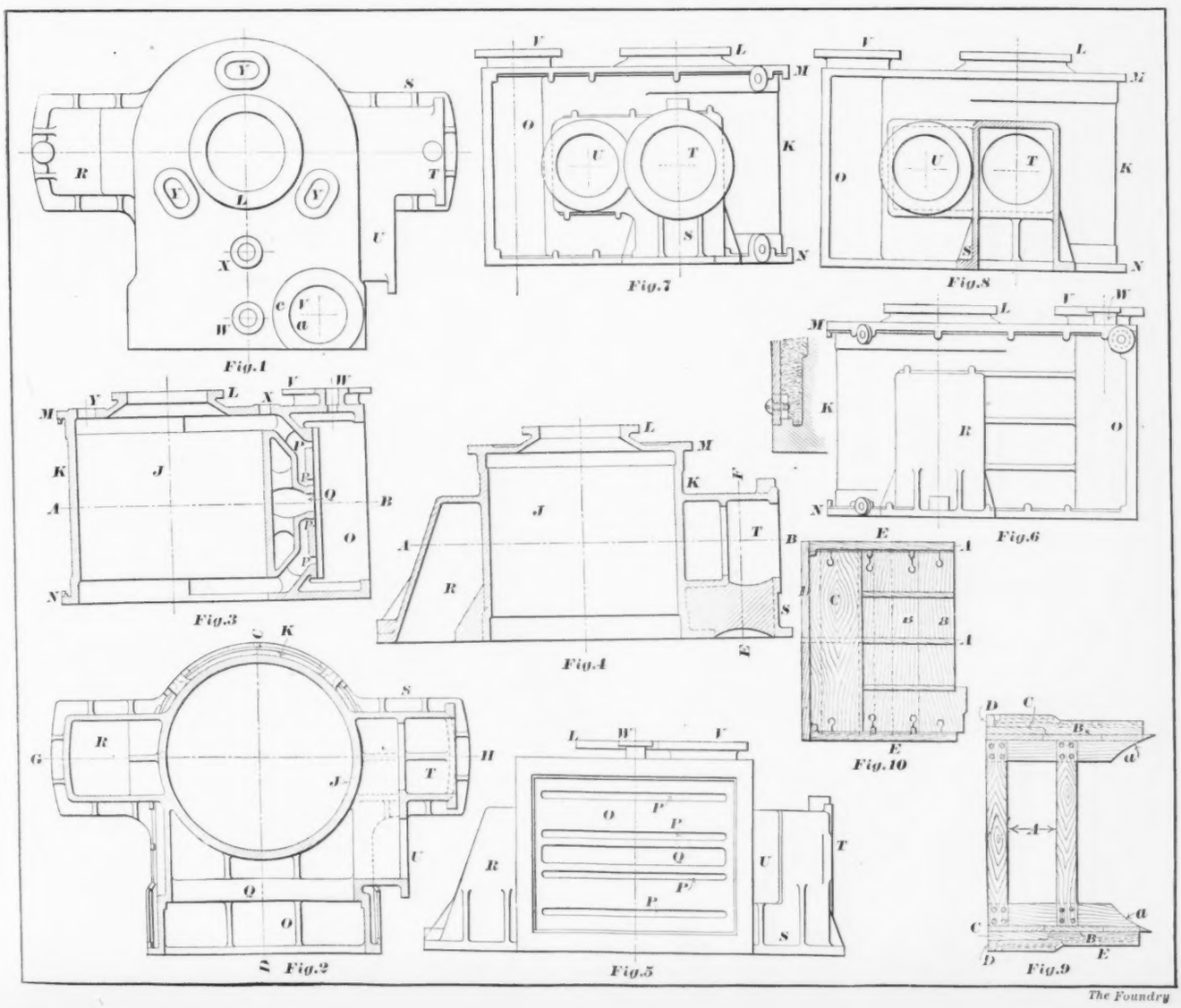
By Joseph Horner

IN THIS article a method of molding a low pressure tandem engine cylinder in loam, will be described. Before discussing the pattern work and molding, the several parts shown in Figs. 1 to 8, should be noted.

Fig. 1 is a plan view of the cylinder from above as it stands when in service. Fig. 2 is a sectional plan view from above taken in the plane *AB*, Fig. 3, which is a sectional elevation taken through the body and passages, that is, along the plane *CD*, Fig. 2. Fig. 4 is a sectional elevation through the body and wings or feet, or along the plane *GH*, Fig. 2. Fig. 5 is a face view of the steam chest and ports with the feet seen lying beyond, at the right and left. Fig. 6 is an outside elevation taken against the plane foot. Fig. 7 is an elevation taken on the other side showing the exhaust passages to the condenser and to the atmosphere, together with the foot on which they are located. Fig. 8 is a sectional elevation taken through the plane *EF*, Fig. 4, cutting through the exhaust passage to the condenser.

For convenience of future reference the principal parts are denoted by the following letters, common to the several views: *J* is the bore; *K* the outside or body; *L* the flange to which the high pressure cylinder is bolted; *M* the top flange necessary for lagging; *N* the bottom flange; *O* the steam chest; *PP* the steam passages; *Q* the exhaust passages; *R* the plain foot or wing; *S* the foot with the exhaust branches; *T* the exhaust to the condenser; *U* the exhaust to the atmosphere, either being opened or closed by means of a valve in *T*; *V* is the steam inlet into the steam chest; *W* the stuffing box to the steam chest; *X* the facing for the escape valve and *Y* the hand holes.

The cylinders are of course lagged. In several of the illustrations the strips on the inner faces of the flanges are indicated against which the wood lagging is laid, and the bosses into which the screws are tapped that secure the steel sheet outside the wood. These are seen in plan in Fig. 2 and in elevation in Fig. 6. An enlarged sec-

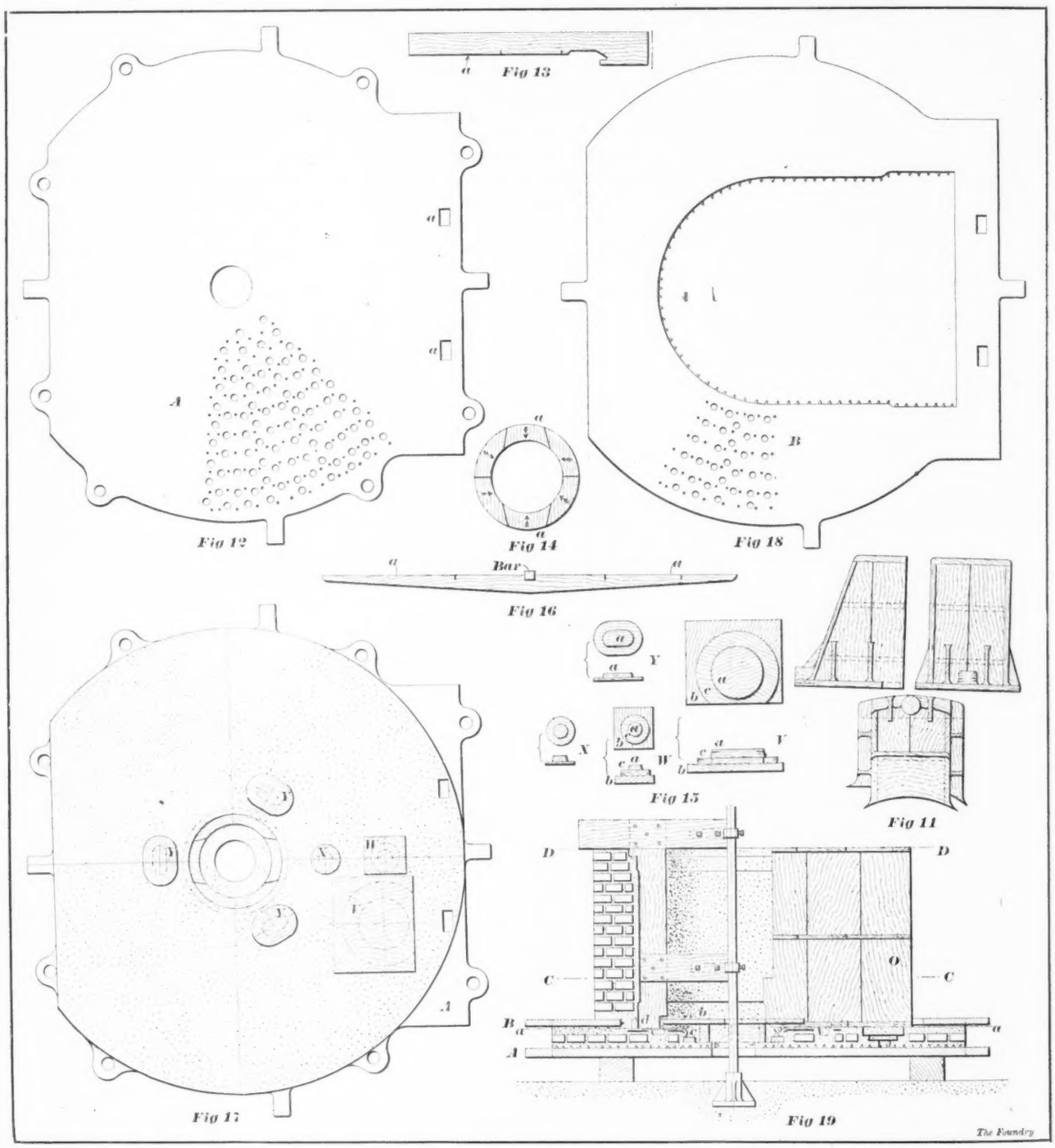


tional detail is given at the left, Fig. 6, showing the non-conducting packing material, the wood lags, and the steel casing.

The cylinder being of large dimensions is the reason why a complete pattern is not made for it. The body was swept in loam, and the fittings which could not be swept were made in pattern parts in wood and bricked up around the body. These fittings comprise the steam chest, the wings or feet which bolt upon the engine standards, and sundry minor details.

Taking the pattern parts first, the steam chest body, being of large size, is conveniently framed together in the manner shown in Figs. 9 and 10. Three frames *A*, *A*, *A* are made of strips united with half-lap joints, Fig. 9. The two outer frames are set apart at a distance equal to the depth of the steam chest, Fig. 10. The third is set midway between. Upon these frames, strips *B*, of any convenient width, are screwed or nailed to form the sides of the steam chest body which flank the passages. Other strips, *C*, are fastened on to form those portions of the steam chest proper which flank the valve. Flanges *D* are fastened upon the latter, and horizontal flanges, *E*, *E*, are fitted around the top and bottom edges in correct position. There are lagging strips, and also lugs for lagging wired loosely on the inner faces of the flanges, and sundry bosses are also fitted on. As these parts are shown they need not be specifically described.

It will be noted that no print is attached to the steam chest face for carrying the main steam chest core. It is not necessary for support, as it would be in most cylinders of small dimensions, and it is not required for insur-

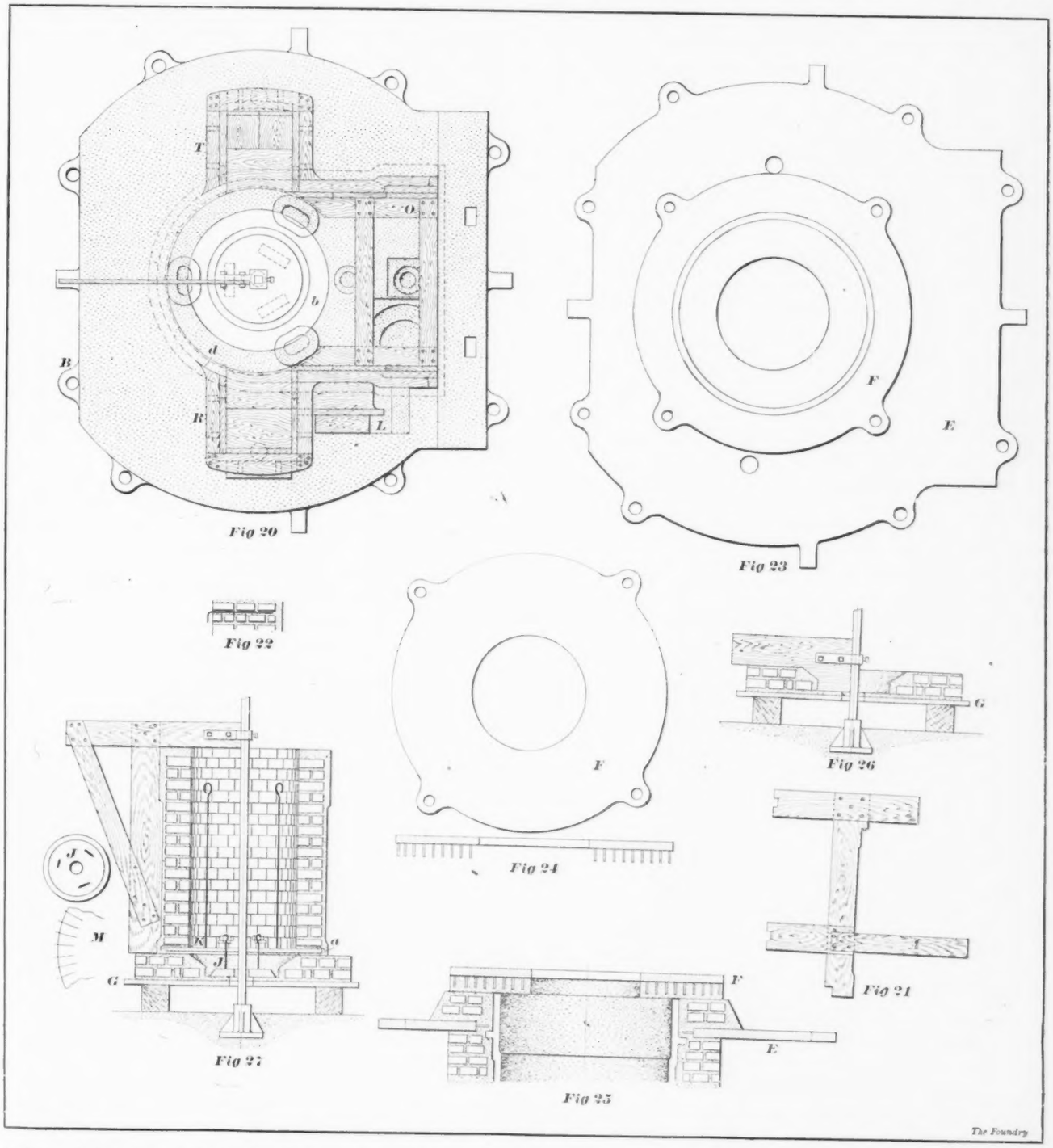


ing correct thicknesses of metal between the core and the body, which can be obtained by direct measurement when setting the cores. Neither is it necessary for securing the core, which is better done by means of screw bolts. The back portion of the body at *a*, *a* is cut to the same radius as the cylinder loam is built against them as there is at the sides, the top and bottom being wholly formed in the top and bottom plates of the mold. This completes the pattern of the steam chest.

Fig. 11 shows the pattern for one of the feet, *R*, Figs. 1 and 4, being without branches. It is boxed up as shown, and carries the larger branch, the shorter branch being made separately and placed alongside the other. Both are boxed.

Making the Mold.

The first step in building-up the mold is to cast a bottom plate, Fig. 12.



body, and the edge of the striking board works against that portion. There is nothing in this section except the edges of the frames, *A*, and the parts of those vertical strips *B* which come to the edge. The top and bottom frames *A*, *A* are also open, skeleton-like, because these are not working parts, that is, no the inside edges are cut like those of the steam chest to the radius of the cylinder body, and the striking board works against those edges. The flanges, brackets, and boss require no further explanation. The other foot, *T*, Figs. 1, 2, 4 and 7, which contains the branches, is made in two parts. The foot proper This is made large enough to extend well beyond the area covered by the entire casting, comprising the cylinder body, steam chest, and feet. Lugs are cast on with holes for bolts, a center hole for the striking bar to pass through, two holes, *a*, *a*, for bars for the attachment of a plate to cover the

steam chest face, and sundry small holes for venting and to facilitate breaking after the casting is made. The plate is about 3¼ inches thick. It is set on the floor, and leveled, with the striking bar in the center. The plate, shown in place at *A*, Fig. 19, is first completely covered with a layer of bricks, with joints from ¾ to 1 inch wide, which are cemented with loam, but have many interspaces filled with fine, sifted ashes for venting. Then the first striking board, Fig. 13, is screwed to the bar, and the flange portion corresponding with the flange, *L*, in Figs. 3 to 8, is swept. The loam around the flange is allowed to stiffen somewhat while the molder is occupied in placing a second layer of bricks around the outside edges of the plate to bring that portion of the mold nearly up to the joint edge, *a*, of the board. When the loam around the flange has stiffened, a pattern flange, Fig. 14, is laid in the impression to preserve the shape of that portion intact, while the superincumbent loam is built over it. This flange is cut, as shown in this illustration, that it may be drawn back after the portion of loam above it has been dried. The flange being divided by saw cuts as shown, the two pieces, *a*, *a*, are drawn in first in the direction indicated by their arrows. Two other pieces follow next in a curved direction, and the remaining two pieces last.

But before this flange is withdrawn, the other portion of the mold is built on the bottom plate, as follows: There are three hand holes, *Y*, Fig. 1; the steam inlet, *V*, to the steam chest; the steam chest stuffing box, *W* and a small facing and print *X* for the escape valve over the passage. These, already prepared with their prints, have center lines marked on their backs by which they are now set upside down in the mold. They are all shown in the group, Fig. 15, the parts marked *a* being core prints for the center holes, and those marked *b* being core prints for forming the necks of the branches between the backs of the flanges, *c*, and the end face of the steam chest, which coincides exactly with the joint face between the bottom plate and the middle part of the mold. A comparison with the branches in Figs. 1, 3, 5 and 6, will render these relations clear.

Assembling the Mold.

To set these various parts in position it is necessary to have a center line across the mold. As the striking bar and board now occupy the central part, a strip, Fig. 16, notched to fit halfway across the bar, is cut, and the edge, *a*, coincides with the center line by which the branches and facings are set. When the center lines marked on the back of the pattern branches in Fig. 15 are coincident with the edge of the strip, they are radial and true. To get the distances of the centers out from the center of the striking bar, the correct dimensions are marked either on the edge of the striking board, Fig. 13, or on the edge of the strip, Fig. 16, and the branches and facings are then adjusted until their centers coincide with the centers thus marked. After all the pieces are thus set by measurement to their positions, the loam is allowed to stiffen, the bricking-up and the loaming-over being completed. Fig. 17 shows the plate at this stage with the pattern parts in place. When the loam has well stiffened the pattern pieces are withdrawn—oil and sand which has been rubbed over them previously facilitating their withdrawal—and then this portion of the mold is run into the stove and dried.

There is now a plain joint between this plate and the body of the mold which has to be subsequently built-up, the joint face being exactly coincident with the face of the bottom flange around the cylinder and steam chest.

Building the Body of the Cylinder Mold.

The second stage of the building-up, that of the body, is done upon a plate, Fig. 18. The opening is made to clear the bodies of the cylinder and steam chest by about 2 inches all round and the outside coincides approximately with the outline of the bottom plate in Fig. 12, and its thickness is about the same.

This second plate, *B*, upon which the cylinder body has to be built-up, is laid in position over the bottom plate, *A*, which contains the facings and branches, Fig. 17, and is centered properly from the sweeping bar, Fig. 19. It need not rest at present directly on the bottom plate, as shown, but may, if more convenient, be supported on blocks elsewhere for the time being, since at the present stage it is placed there temporarily for the striking of the outer portion of the mold, after which it will be removed during the striking of the central core.

A plate, *b*, Fig. 19, is cast and laid upon the center portion, on which plate the molder will stand while striking the cylinder body. The steam chest pattern, *O*, and the bottom flange, *C*, Fig. 14 (bottom during the molding), and the flange *d*, shown in elevation in Fig. 19 and in plan in Fig. 20, are laid in position, careful measurement being taken from the central bar, and the center line of the steam chest is located upon the center line of the bottom plate.

Bottom Flange.

The bottom flange, *d*, must be made in wood segments and laid in the mold. It could be swept by the board if it were a plain flange only; but it carries also the strips for the inside faces of the wood lags, and the lugs for the button head screws which secure the steel lagging. These could not be bedded-in if the flanges were swept, as they can be in the case of the top flange. This is the reason for the difference between the wooden flange with strips and lugs below and the swept flange above, with its curved strips and the lugs only bedded-in in wood. In the steam chest, as shown by the pattern in Fig. 10, the strips and lugs are skewered on loosely.

No bricking-up is done against the vertical face of the steam chest, but only on both flanks. This face of the chest is left open and the bricks on the flanks are loamed-over level with the face, Fig. 20, to form a joint with a plate, which will be shown later. This also leaves an open space as wide as the distance over the steam chest flanges, through which the pattern is withdrawn horizontally.

Venting the Mold.

After the steam chest is laid down and set by measurement only, a portion of the bricking-up is done around it; at first only the portion nearly up to the level of the ends of the feet, *R* and *T*, Figs. 4 and 5. At this stage a tongue piece, *A*, is screwed on the sweeping board, Fig. 19, and shown separately in Fig. 21, to strike-off a bed of loam just level with the faces of the feet on both sides, upon which they will rest. This is in the plane *CC*, of Fig. 19. The bricking-up is then continued around them. Before they become too firmly held in the brickwork, exact adjustments for position are made by means of measurement and checking of the center lines and edges which come uppermost, in various ways. Also, on the side where the exhaust branches come, vent pipes of about 4 inches bore are embedded in the bricks to carry off the gases from the cores. At about two stages in the course of bricking-up, long rods of about ½-inch diameter, Fig. 22, are laid radially between courses of bricks reaching from the center to the outside. These are subsequently withdrawn on the completion of the mold, leaving large vent holes through which much of the steam generated in casting es-

capes. These have to be inserted because of the great width of the brickwork at some sections, and it is of course only over the wider areas that the rods are built-in. They are laid from 6 to 8 inches apart. The bricking and loaming is then finished and swept-off level with the joint face, *DD*, Fig. 19.

Head Metal.

The head metal is formed distinct from the body of the mold in the following manner: The main covering plate, *E*, of the mold, Fig. 23, is made to the same external outline and dimensions as the main bottom plate, but thinner, being only about 2 inches thick. A hole is cast in the center, Fig. 25, about 1½ inches larger than the outside diameter of the head metal, which is of course of the same diameter as the body of the cylinder. The inside of the hole is prodded with gaggers to retain the loam. Loam is struck over the whole of one face of the plate—the face which goes lowermost in the mold—and this forms the top face of the actual cylinder casting, level with the flange, on top in the casting, but the bottom when the cylinder is in place. This is perfectly level. When it is dried the plate is turned over, bringing the bare face uppermost, and a sufficient thickness of loam is daubed on to bring up the required thickness for head metal measured from the face already loamed. The additional thickness of loam is spread out beyond the edge of the center hole for 10 or 12 inches, Fig. 25, sufficient to give a good area to receive and make a good joint with the final covering plate, Figs. 23 and 24, which has to go on the larger plate. At the same time loam is daubed and swept round the edge of the hole against the gaggers and up to the face. This is now completed, ready to go into the stove for drying. It is obvious that when the mold is cored and the large plate is laid in position upon the body of the mold and encircling the center core, which is made long enough to come through the head metal and is covered with the small, top plate, Figs. 24 and 25, that the mold, including the head metal, is complete, waiting only for the cores, the bolting together, the formation of the pouring basin, and the taking off of the vents.

Making the Central Core.

The central core, as will be noted in Fig. 3, is smaller at one end than at the other. The smaller end is in the bottom of the mold. The method adopted in striking it is as follows: A loam plate, *G*, Fig. 26, is first made, and a reverse mold in loam is struck upon this, being supported upon bricks. Fig. 26 shows the plate, *G*, the striking board, and mold, in section. This is used as a dummy mold from which to take an impression for the bottom portion of the central core, which would otherwise have had to be swept bottom face upwards, and then turned over. Another reason in this case was that three cylinders of this kind precisely alike were ordered at one time, and so the dummy mold served for taking impressions of three cores. To preserve the face of the dummy mold it was well painted with tar.

Building Cores on Iron Plates.

The core is built up upon iron plates in the following manner: In the bottom of the mold is laid a circular iron plate, *J*, Fig. 27. Strips of paper laid over the face of the mold, swept as in Fig. 26, makes a parting joint, and loam is daubed over the plate around the sloping sides and over the flat face of the mold to a thickness of approximately 1 inch. Then another plate, *K*, Fig. 27, is laid upon and pressed down upon the loam, this plate carrying the superstructural portion of the core. The plate, *K*, is provided with three rods with eyes by which it is lifted. Three holes cast about the center receive rods with eyes coming up from the small central plate, *J*. The two plates are secured in this way with wedges driven through the eyes, as shown in Fig. 27, thus holding the plates together. Several 2-inch holes cast in the large plate hold the loam which is squeezed into them, the holes assisting to secure the loam on the bottom face. Upon this plate the bricking-up of the main body of the core is done.

The main core plate, *K*, upon which the bricking-up is done is made 3 or 4 inches less in diameter than the core itself, that the casting shall have room to shrink upon the core without risk of being cracked by the unyielding plate. To support the loam that lies beyond the edge of the plate, rods are laid around the edges as shown at *a*, in Fig. 27, and detailed in plan at *M*, the rods being ⅜-inch iron, bent and laid about 2½ inches depressed all round the edge. These sustain the loam, and yet will yield to the shrinkage of the casting.

A thick layer of loam is then daubed over the plate and the rods, and the bricking-up follows. To provide for the shrinkage of the casting three courses of loam bricks are built-up. As these are crushed by the shrinkage of the casting they allow the latter to close in on the core without risk of fracture. The bricks are made in a wooden box and dried.

The common bricks are built between the loam bricks up to the top, and loam is struck over all roughly with the board set as shown in Fig. 27. The roughed-up mold is then allowed to stand for a few hours to stiffen, other work on the job being proceeded with in the meantime. Then a final coat of fine, sieved loam is struck-over, finishing the core, which is then lifted by the three rods and eyes and run into the stove and dried.

Semi-Steel

By N. W. Shed

Question:—We are using from 10 to 20 per cent steel in our cupola mixtures, to lower the cost of our castings. The steel is very light, consisting principally of horse shoes, and costs us $11 per ton. Our melting losses are very heavy and we would like to know whether you consider it economical to use steel. We can purchase good machinery scrap at $13 per ton.

Answer:—If the scrap is very light and rusty, there is liable to be a heavy loss in melting. In this case it would be advisable to use scrap cast iron, even if it is a trifle more expensive. By charging light scrap on the coke and covering it with fine coke, and then charging the pig and scrap, it is possible to melt comparatively light scrap with little waste. If you can buy boiler plate clippings, structural steel scrap, or old rails cut to short lengths for the same price as cast scrap, it will be economical to use this material. The main object in using steel is to obtain a close-grained, strong casting, without reference to the saving in cost.

Tin Cans for Sash Weight

By W. J. Keep

Question:—We are melting scrap tin cans in our cupola, the melting ratio being 5 to 1. The amount of coke required seems excessive.

Answer:—If you are obtaining good sash weights your melting ratio is not too high. You should compress the tin cans into bales, having dimensions of approximately 12 inches each way. If you have any trouble, add sufficient pig iron to this scrap to make the iron fluid enough to run. Silicon will not materially help you. One ounce of aluminum to 100 pounds of the melted product will make it quite fluid.

A PACIFIC COAST GRAY IRON SHOP

A western foundry which compares favorably with the most modern eastern plants in both construction and equipment

IN APRIL, 1906, practically the entire city of San Francisco was destroyed by fire and earthquake and the immediate effect of this calamity on the iron industry was an almost total paralysis of activity among the foundries, machine and structural shops. There were very few plants that were not either wholly or partially destroyed. During the last four years, however, the reconstruction has been carried on vigorously, until today the physical equipment of the iron working industries of San Francisco is equivalent to, and in some instances, superior to what it was before the earthquake. Many new plants have been built, not only in San Francisco, but also in Oakland and Alameda, across the bay from their former locations.

The Geo. E. Dow Pumping Engine Co., 413 Sheldon building, San Francisco, erected its new plant in Alameda. After the fire in 1906 this concern started the reconstruction of its works and it was decided to erect the new plant of wooden frame construction, rather than steel. The destruction of many steel frame buildings led to the erection of many buildings of heavy mill construction, as it was found that the large timbers resisted the fire ravages better than any other building material.

The Plant.

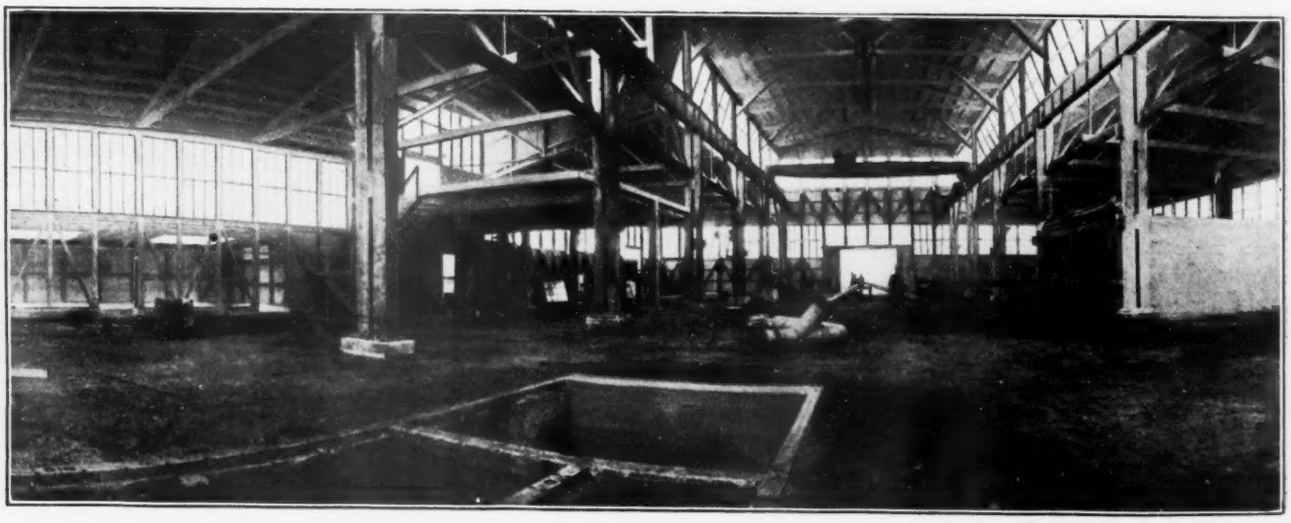
The erection of the present plant in Alameda was commenced as soon after the fire as possible and was completed early in 1910. It consists of machine and pattern shops, power house, foundry and office, well arranged and ample space is provided for extensions. The transportation facilities are unexcelled, consisting of both rail and water shipping facilities, the plant being located on water front property on San Antonio creek, emptying into San Francisco Bay. In general arrangement the entire plant is built to permit of the continuous movement of the product from one department to another through the successive stages of manufacture, until ready for shipment. Between the office and wharf on the river front are located the foundry, power plant and machine shop, and between the foundry and the river are the sand bins, pig iron, scrap and flask storage yard.

The Foundry.

The main foundry building is 210 x 125 feet and is of timber construction throughout, with a composition roof. The center bay has a height of 40 feet and the columns are heavily reenforced to carry the traveling cranes, the cross girders being designed to carry 70,000 pounds on 10-foot centers. The gabled main bay is provided with a monitor roof and there is an auxiliary bay on either side, 20 feet high. The monitor roof extends the full length of the bay, providing light and ventilation. A concave cornice is trapped around all eaves of both the main side bays, giving the exterior a pleasing appearance. In the construction of the building the relation of the height and the width of the auxiliary and main bays have been carefully determined to insure a uniform distribution of light over the entire floor of the foundry building. Both side bays are 30 feet wide and 20 feet high, while the main bay is 60 feet wide and 40 feet high. All windows are placed as high as possible from the ground and are continuous around the entire plant. Above the lean-to roof of the auxiliary bays on both sides of the center bay, are the windows lighting the main floor. These windows are slightly inclined to provide the maximum area for the entrance of light. With the double window system the diffusion of light is practically uniform.

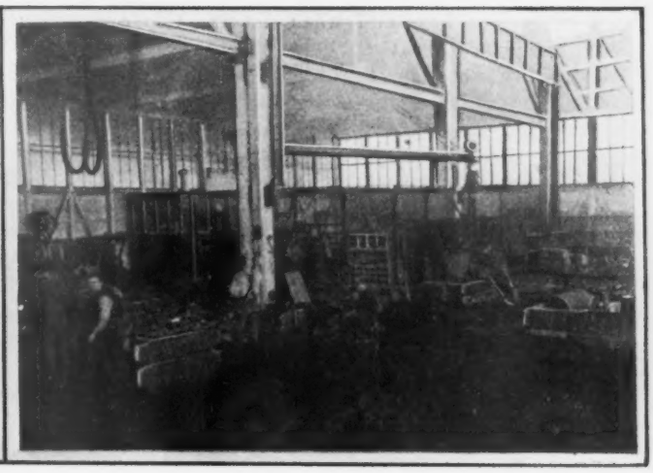
Foundry Layout.

Everything necessary for the foundry operations is carried under one roof. Entering from the flask yard at the back, the flask shop is located on the left and the brass molding floor on the right. The two brass melting furnaces are located in a separate building. The remainder of the right bay is divided into two molding floors with a cupola in the center, thus facilitating the handling of the metal from the furnace to the molds. In the other side bay are located the



GENERAL VIEW OF THE GEO. E. DOW PUMPING ENGINE CO.'S FOUNDRY, SHOWING GENERAL CONSTRUCTION OF THE BUILDING AND LARGE CASTING PIT IN THE FOREGROUND

THE CUPOLA AND CHARGING FLOOR WITH ADJACENT MOLDING FLOORS FOR SMALL WORK



A VIEW OF THE BRASS DEPARTMENT

mold drying ovens, core ovens, core benches, as well as the machine molding floor. Castings are cleaned, weighed and shipped at the extreme end of the foundry.

Internal transportation is provided by two 10-ton electric traveling cranes and four 1-ton jib crane hoists placed on 30-foot centers. The traveling cranes have a runway of 210 feet and a span of 60 feet. Every column in the main bay of the foundry is provided with the necessary bearings, so that the crane brackets can be shifted as desired. No industrial railway has been installed, as all of the material is handled by traveling cranes and the molding floor is consequently not broken up.

Raw material and flasks are handled in the yard by an industrial railway that reaches every part of the plant, including the pattern storage, machine shop and the charging floor and all wooden flasks are stored outside of the foundry in the flask yard accessible to the industrial railway track. The iron flasks are stored inside of the foundry.

Melting Equipment.

The iron is melted in two cupolas, 40 and 34 inches in diameter, respectively, and the charging floor is reached by an elevator connected with a spur from the industrial railway system extending through the pig iron and scrap storage yards. Both cupolas are provided with two tapping spouts to facilitate the rapid handling of the iron. In the center bay is a concrete casting pit for large work. Most of the large molds are made on a jar-ramming molding machine located in the center of the main bay. About 75 per cent of the castings produced are used in the manufacture of pumps and the remainder of the work consists largely of gas engine cylinders.

The cost system installed provides for the tracing of all material by perpetual inventory. When an order is received all data and specifications are placed on one sheet, of which 14 copies are made, one copy remaining in the office files and every department that can possibly have any connection with the work is furnished with a copy of the order. When the job is completed the job cost sheets are filed and they become the cost record of the job. From the "key book" maintained, it is possible, at any time, to locate the patterns that are available, the drawings, the time when the work was completed, its cost and the time required for its manufacture.

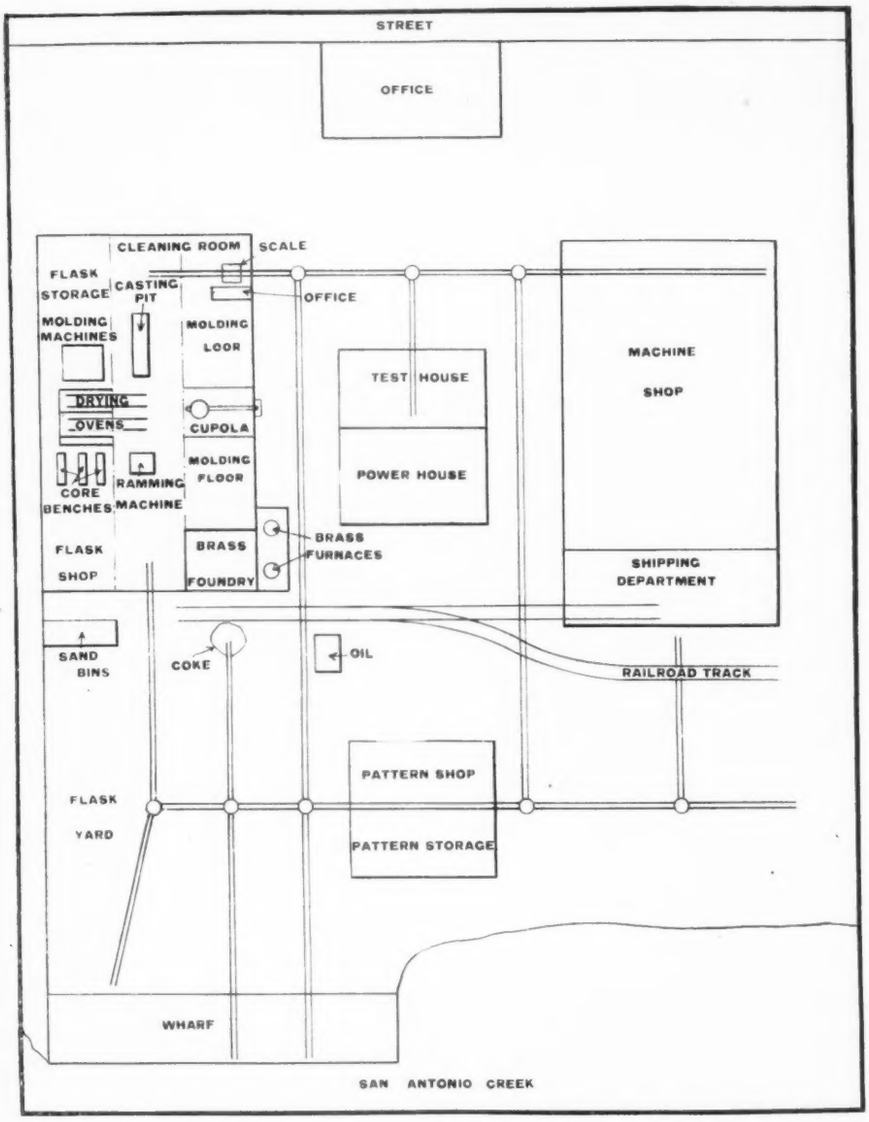
A part of the system of this plant is indicated by the shop key board located in the main hallway of the office. It is numbered from 1 to 199 and is provided with a hook for each number. At the side of the board is a diagram of the plant on which every part of the works where a key is used is given a designated number. Certain employes are assigned the

THE PIG IRON STORAGE YARD, POWER PLANT AND PATTERN SHOP

THE FOUNDRY IS WELL PROVIDED WITH WINDOWS, INSURING AMPLE LIGHT AND VENTILATION

use of various keys and when not in use are placed on the hook corresponding to the number of the man authorized to use these keys. It is thus possible to see at a glance whether any given key is in and who is responsible for it.

While labor-saving equipment is used extensively throughout the plant, no tools have been installed for an operation that could be accomplished more cheaply by hand, and vice versa, and records are constantly maintained to determine just where the line should be drawn. No premiums nor bonuses are given. Every convenience and appliance is provided for obtaining the highest efficiency, the very best tools, good ventilation and an abundance of light, together with well planned operations, combine toward obtaining the highest returns with the least outlay. The climate in, and near San Francisco, is such that every man can work comfortably throughout the entire year. This insures the maximum output per molder at all times.



GENERAL ARRANGEMENT OF THE GEO. E. DOW PUMPING ENGINE CO.'S NEW PLANT

Congress of Technology

What promises to be a very remarkable and striking record of the importance of science to modern industry will be presented in the series of papers which will constitute one of the main features of the Congress of Technology, to be held in Boston, April 10 and 11. The first of these dates is the fiftieth anniversary of the chartering of the Massachusetts Institute of Technology, and the primary purpose of the congress is to fittingly mark this anniversary. A number of graduates of this institution, who have been conspicuously successful in various lines of engineering, will present papers at the congress.

Tinning Gray Iron Castings

By N. W. Shed

Question:—We are making a line of meat choppers, but are unable to tin them satisfactorily. We are of the opinion that our tinning process is not at fault, as we experience no trouble with the wrought iron and malleable parts, which are tinned the same as the cast iron parts of the chopper. The pig iron we are using contains, silicon, 2.75 to 3 per cent; 0.021 to 0.025 per cent sulphur; 0.65 to 0.70 per cent phosphorus and 0.65 to 0.75 per cent manganese. Our cupola charge consists of 900 pounds of pig iron; 300 pounds of remelt scrap and 350 pounds of local scrap, principally agricultural. After the castings have been tumbled they are placed in a wet mill for about 8 hours and are subsequently pickled from 2 to 4 hours. Our cupola is lined to 36 inches and we melt 5 tons in 60 to 65 minutes from the time the blast is put on, the pressure varying from 8 to 10 ounces.

Answer:—Both wrought iron and malleable cast iron can be easily tinned, but the tinning of gray iron is an entirely differet proposition. For many years it was believed impossible to tin gray iron until a method was evolved by W. T. Flanders of Nashua, N. H. The mixture you are using for these castings seems satisfactory and the iron is apparently sufficiently soft. More difficulty is experienced in tinning hard castings than in tinning those made of soft iron, but if the necessary precautions are observed it will be found possible to tin almost any gray iron castings. In this case your difficulty is undoubtedly due to over-pickling. The acid eats into the iron, leaving a slimy coating of silicon and graphite, which prevents the tin from adhering. This will be found particularly true when sulphuric acid is used in the pickling solution. We would suggest that you use hydrofluoric acid for removing the sand from the castings and after they are cleaned in this way they should be tumbled in a barrel containing a weak solution of muriatic acid and sal-ammoniac. This barrel should be fitted with valves to maintain a constant pressure of hydrogen gas, which will prevent the air from coming in contact with the castings. To insure good tinning the castings must be absolutely free from dirt and oxide and they should be kept under water in storage tanks until they are ready to be tinned. After the castings have been sufficiently tumbled they are

washed in water, then immersed in a hot bath of caustic soda and again rinsed in water. Before immersion in the flux they are pickled a few minutes in a solution of muriatic acid.

The flux is made of strong chloride of zinc to which sal-ammoniac is added. This flux is also used to cover the bath of melted tin and keeping the flux clean and fluid is an important feature of this operation. The castings are dipped in the zinc flux and are then immersed in the melted tin, remaining therein about 15 minutes. The tin should be kept at a temperature of about 500 degrees Fahr. For an extra finish it is advisable to have a second tin kettle in which the castings are dipped after receiving the first coating. The melted tin in the second kettle should be maintained at a temperature of about 400 degrees Fahr., and should be covered with lard oil. For the details of this process we would suggest that you consult "Tinning and Galvanizing," written by W. T. Flanders. The casting submitted, which has been dry-milled, is smooth enough for tinning, but the sand has not been removed from the corners and the surface should be thoroughly cleaned before attempting to dip the castings in the tin. The tinned casting submitted shows the effects of the formation of oxide in the process of cleaning. A few minutes exposure to the air after treating with the acid will produce a film of rust, so that care must be exercised in placing the castings in storage tanks. By following these directions carefully you will find it possible to satisfactorily tin gray iron castings.

The Efficiency of the Permanent Mold*

By Edgar Allen Custer

IN CONSIDERING the question of using permanent molds in the foundry it should be thoroughly understood that we must approach this question with new ideas, and from a new viewpoint. Molding in sand and molding in permanent molds are as far apart as the poles. Although we use the same pig in both processes, yet the results show such vast differences that, in order to get a sound basis, they must be considered as not being comparable, except when the question of the cost of castings is to be ascertained. To successfully use permanent molds one must abandon all the preconceived ideas as to the behavior of the molten metal and must forget all the theories and the effects that influence and affect molding in sand. To all intents and purposes the use of permanent molds is a separate and distinct art. The casting it produces is an entirely different metal from the same casting when made in sand, even though made from the same iron. The difference is not chemical, but is purely physical.

Properties of Permanent Mold Castings.

The permanent mold castings differ from the sand castings not only in their physical structure, but in their characteristics. A soft, open pig iron, high in graphitic carbon, becomes a close-grained iron showing no traces of the graphitic flakes, but having the same amount of free carbon as existed in the original pig. It is capable of being magnetized, permanently retaining the magnetism; it can be tempered and hardened precisely the same as a bar of tool steel and, when tempered, will make a cutting tool equal to the best non-alloy carbon steel. This latter fact is true, irrespective as to whether the original pig was high or low in silicon. There are no spongy spots and the castings are free from shrinkage strains. The casting can be taken from the mold at a bright red heat and plunged in cold water until cold without showing a sign of cracks. High shrinkage does not begin in a permanent mold casting until a very low heat is reached, 1,200 degrees to 1,400 degrees Fahr. being the point at which the casting must be removed to prevent shrinkage, cracking the undercut parts. Again, when a permanent mold casting is hardened until it is unmachinable it only requires heating once to a red heat to restore it to a soft, strong metal. None of these characteristics is shown in sand-made castings, and it must be borne in mind that these characteristics are invariably true in a permanent mold casting, irrespective of whether the silicon is high or low.

Basis of Custer Process.

Molten iron, when poured into a mold, first swells until the point at which it begins to set is reached; then the bulk remains at that point for a short space of time while the cooling progresses, and then it shrinks until cold. The interval between the point at which it sets and the point at which chilling begins, is long enough to enable the workman to remove the casting from the mold, and in that time it will be sufficiently hard to be handled without fear of distortion or breakage. Since it has been determined definitely that iron does not chill until some time after it has set the main object of the process then is to set this iron as quickly as possible, and, when this is done, to instantly remove the casting from the mold. To accomplish this, the molds are made of quite a large bulk so that they will have a large heat capacity. A further object in making these molds of such large bulk is to prevent any distortion from the heat action. In the original molds the castings are removed frim the mold within five or six seconds after the pouring is accomplished. In molds where permanent cores are used the permanent cores are removed immediately upon the completion of the pouring and the casting taken from the mold generally within six or ten seconds.

Chemistry of the Process.

Coming now to the elements that influence the production of machinable castings in permanent molds, it may be stated that the hardeners which make it difficult to produce a machinable casting in permanent molds are high sulphur and high manganese. Phosphorus has little or no effect; it produces no weakening of the metal even when used in quantities as high as 1 per cent. The function of silicon is simply that it lengthens or shortens the interval between the setting point and the chilling point, when it is respectively high or low. A 3 per cent silicon pig will not make a casting any softer than a 1½ per cent silicon pig, nor will a 1½ per cent silicon casting be any harder than a 3 per cent silicon casting. Manganese, when in excess of 0.60 per cent, is a detriment. It does not increase the strength of the casting, but renders it brittle and weak. It is to the permanent mold process what sulphur is to the modern foundry.

Carbon, however, plays an important

*Read at the February meeting of the New England Foundrymen's Association.

part in this process. Carbon exists in molten iron in solution and is then in the combined form. If molten iron is instantly chilled and solidified all the carbon will still be in the combined state and there will be no free carbon in the metal, assuming that the metal could be chilled instantly to a black heat. In actual practice, however, when the foundry iron is chilled swiftly from the molten state all the carbon at the time of setting is in the combined form, but as it cools a certain proportion of the carbon is changed into the free state, although not in the form which is commonly known as graphitic. The free carbon collected after dissolving the iron will be found to exist in such a fine powder as to have no crystalline formation, even under a high power microscope. This form of carbon is commonly known as annealing carbon and will be found in malleable castings. It is a desirable form of carbon and in order to get it in as large proportion as possible it becomes necessary to chill the metal swiftly and to do this we have adopted the use of large iron molds of so great a bulk that their heat capacity is sufficient to accomplish this result and, at the same time, not overheat the molds. The question next advanced is that while it is evident that this sudden chilling can be accomplished with castings having a thin section, with castings having a thick section, say 2 inches square, it would be necessary to set them to their full thickness, to hold them in the mold so long that the outer portion would become chilled. Here is where we take advantage of the well-known fact that iron increases in bulk from the molten state until it reaches the point of setting. If, then, a casting of large section be poured in an iron mold of the required bulk, the outer portion, say ¾ inch in depth, sets almost instantly and the interior of the casting remains molten. At this point it is removed from the mold and the casting now has a hard set exterior with the interior in the molten state, and, as it loses its heat, the molten iron in the center tries to expand. This expansion is held in check by the hard walls. The force, therefore, is turned back upon the molten metal, and this produces, when cold, a uniform, fine grain from the center to the outside of the casting. There can be no chilling of the metal, since the casting is removed from the mold before the chilling point is reached and the natural physical force of cooling accomplishes the desired result. It is well known that it is almost impossible to cast a ball 6 inches in diameter, in a sand mold without the interior being more or less spongy. It is just as impossible to cast the same ball in a permanent mold with the interior spongy.

Shrinkage Strains.

Castings produced in permanent molds have no shrinkage strains. In explanation of this we must go back to the question of the molten iron. Molten iron is homogeneous and if this iron is instantly chilled beyond the setting point it would still be homogeneous; there would be no chance for segregation. The sulphur, phosphorus and carbon would remain in the same relative positions that they occupied when in the molten state, but since the mass was all cooled at precisely the same rate it becomes evident that no shrinkage strains could be possible. It is obviously impossible to cool iron instantly, but approximately the same result can be obtained if it can be chilled fast enough to prevent segregation. If a casting, say 1 inch in section, be made in sand it would require at least a minute before it could be removed from the sand without breaking or distorting. In this time the different elements segregate and different portions of the bar are cooled at different rates. Consequently, shrinkage strains are set up that become more marked when a portion of the casting is much thinner than the other, or when a thin section is joined to a heavy section at right angles. A permanent mold casting of this thickness, however, can be removed from the mold within 2 seconds after it is poured and the time in which segregation is possible is reduced from 60 seconds to 2 seconds. Hence all the ingenuity of the designer is bent toward the construction of the mold so that the iron can be introduced quickly and the mold opened and the casting removed with the least possible loss of time.

Designing the Permanent Mold.

The permanent mold, therefore, becomes a job for the designer, draftsman and the machinist. All the brains are put into the mold before it goes into the foundry, the primary object being to allow the mold to be worked swiftly, and since quick-working is necessary to produce machinable castings, it follows that large quantities must be produced if the work is carried on continuously. In practice we place our molds in batteries. Eight and ten molds constitute a battery and on each of these batteries a gang of men, generally four or five laborers, is placed. A large ladle, holding 150 to 200 pounds, usually sufficient to pour all the castings in one battery, is pulled on a trolley and the ten molds poured as fast as the pourer can fill each mold and move to the next one. The other men follow up this operation and take out the castings from the molds, seeing that the molds are thoroughly cleaned and closed ready for the next operation. By this method ten castings are generally poured in from two to four minutes and the time necessary to make one casting is the time that is necessary to pour this one casting and move to the next mold. If iron be continuously supplied to the batteries the work can go on from 7 a. m. to 6 p. m. without interruption. No coatings are used on the molds, as they would tend to defeat the main object of the process, that is, the swift removal of the heat. As an evidence of what can be done I present a record of one of our batteries where the castings are larger than those usually poured, being principally Ts and Ys and averaging 34 pounds each. One gang was timed with the following result:

	Castings produced.	Castings lost.
9 to 10 a. m.....	123	2
10 to 11 a. m.....	119	1
11 a. m. to 12 m.....	146	1

In this work the cores were pulled with air hoists and the iron was supplied to the gang in ladles hung on trolleys.

Unskilled Labor.

In April, 1910, I made a statement that this process was not dependent upon skilled labor and that ordinary laborers could be employed upon it without previous experience and obtain economical results. To test this, on Friday, April 21, we hired 18 men from the street, 16 of them could not speak English and but one of them had ever been in a foundry before. On Friday and Saturday we simply pushed these men around and endeavored to teach them not to be afraid of the molten iron. To the 18 men we added three of our more experienced workmen and on Monday these 21 men were turned over to the representatives of an outside concern who assumed entire charge of this portion of the plant. They took account of the number of castings made, the hours worked and the costs that entered into the production of these castings. There were 37 molds. The average molding cost alone for these castings, when made in sand, was 6 cents each, figured on a piecework

basis. The results of this test follow.

	Number hours worked.	Number castings made.	Cost per piece. cents.
Monday	7	896	2.3
Tuesday	10	1,419	2.1
Wednesday	10	1,767	1.69
Thursday	10	1,972	1.52
Friday	10	2,174	1.38

The cost of these castings, when made in sand, for molders' labor alone was $9.02 per ton. The molding cost the last day of this test was $2.14 per ton. To the molding cost of these castings, when made in sand, must be added rumbling and cleaning and the cost of sand.

Life of the Molds.

Each mold is primarily designed to produce 1,000 pounds of castings per day and in one department, containing 37 molds, there were produced 18 tons of good castings in 10 hours. The floor space required by these molds is 60 x 26 feet, and to produce the same tonnage of the same castings in sand a floor space of 400 x 105 feet would be required. Also to produce the same tonnage in sand the services of 54 expert molders would have been required, whose pay would average $3.50 to $4.50 each, per day.

The question invariably asked when discussing iron molds is, "How long do they last?" We have been working them continuously for five years and can only say, "We don't know." The only points where the molds disintegrate are in the runners and gates. The matrix of the mold never, in our experience, shows any signs of wear or crumbling. After we have made from 7,000 to 10,000 castings we generally renew the gates by inserting new blocks. The cost of this repair is generally 10 per cent of the original cost of the mold. We have made 21,000 castings in a single mold, each casting weighing 10 pounds, and the matrix today shows the original tool marks. The life of the mold does not depend so much upon the number of castings that are poured into it as upon the number of times it is allowed to become cold. Working a mold continuously will quadruple the number of castings that may be made before repairs are required.

Frederic B. Stevens, Detroit, manufacturer of foundry supplies and equipment, is sending to the trade a six-page folder, entitled "Bill Nye Had a Dog," which briefly describes and illustrates some of the foundry supplies and equipment made by this concern.

Cast Iron Car Wheels

By N. W. Shed

Question:—Is there any difference in the hardness of the chill in cast iron car wheels if the depth of the chill is approximately the same? What properties will give the best wearing chill for mine car wheels to reduce the number of flat spots? What is the best method of making a comparative test of the wearing qualities of the treads? If a wheel does not break without annealing, would it give better service than one that has been thoroughly annealed? We would also like to know whether the annealing improves the wearing qualities.

Answer:—A considerable difference will be found in the hardness of the chill of cast iron car wheels. The chill of some wheels is intensely hard and will resist the best cutting tools, while other wheels, cast from the same metal, can be cut readily with hardened steel. The cause of this is difficult to explain and a variation in the coke, in the cupola blast, in the temperature of the metal, etc., all have an influence on the hardness of the chill. High sulphur iron will produce a hard chill, but the casting will be brittle. High manganese has a tendency to soften the chill. The best car wheels are made of a low silicon, low phosphorus iron with high total carbon. The manganese in chilled work should be under 0.40 per cent.

Flat spots are frequently due to uneven chilling and approximately 70 per cent of the car wheels produced have an uneven chill throughout their circumference. When the chill wears down, the gray iron surface is exposed and will soon wear flat. Most of the flat wheels are produced by skidding, and regardless of the hardness of the chill a flat spot will be made if the wheel is permitted to slide on a rail a sufficient length of time. The common practice of spragging a mine car wheel is responsible for a large number of flat wheels. If the wheels were allowed to turn slowly under the brake shoes, the number of flat wheels would be materially reduced. There does not seem to be any best method for testing the wearing qualities of the treads. Some makers take a piece of chilled iron and weight it so that a constant pressure is exerted against an emery wheel. By counting the number of revolutions required to make a groove of certain depth, some idea can be obtained of the hardness of the wheel. By heating the best grade of tool steel to a bright red and quenching it in brine, the steel will be hard enough to cut most chilled iron. If this steel cuts the chill with difficulty, it shows a hard wheel of good wearing qualities. Turner's hardness testing instrument weighted with a diamond point can also be used, and the solerometer, also designed for making hardness tests, will give good results. These devices, however, are not in common use in foundries.

The annealing of car wheels has a tendency to soften the chill. The intensely hard austenite, produced by the chill, changes to softer constituents by the annealing process. Car wheel makers, however, do not believe that the chill is materially softened by cooling the wheel in the annealing pit, but if the wheels are reheated and kept at the annealing temperature, the chill will be softened, and if the annealing is prolonged, the chill will finally disappear.

Air-Cooled Cylinders

By N. W. Shed

Question:—We have been attempting to make a semi-steel mixture, suitable for small, air-cooled cylinders. The iron available contains 2.75 per cent silicon. We use 15 per cent steel scrap in the mixture and the metal is coarse and very soft. We also add 1¼ ounces of aluminum to 150 pounds of iron in the ladle. We would like to know whether the trouble is due to low combined carbon. The metal is cast very hot and the castings are shaken out shortly after pouring. We would like some suggestions for making steel mixtures and would like to know the best method of charging.

Answer:—The silicon in your pig iron is too high for a close-grained, hard mixture. With the iron and steel you are using, you would obtain about 2.30 per cent silicon, whereas it should be 1.80 per cent, or even less, if possible. The only effect of the aluminum would be to make the castings still softer. Ferro-manganese is to be preferred to aluminum for this kind of work. A good mixture could be made by using 55 per cent of pig iron, containing 2.75 per cent silicon; 20 per cent scrap; 10 per cent car wheels, and 15 per cent steel scrap. If the scrap is hard, the car wheels may be omitted. Charge the scrap steel on the coke bed, scatter 20 pounds of ferro-manganese on the steel and then add the pig iron and other scrap. If the coke is allowed to burn freely, to heat up the steel before melting, better results will be obtained. The amount of ferro-manganese named is sufficient for a 2,000-pound charge. To obtain the best results, the pig iron, as well as the coke and scrap, should be analyzed. Without an analysis of the pig iron you cannot make your mixture intelligently, as there may be an excess of phosphorus or sulphur, which will

PATTERN NO. 8011

NAME Cylinders

DESCRIPTION	LOOSE PIECES	CORE BOXES	LOOSE PIECES	SHRINK	MASTER PATTERN SECTION	MASTER PATTERN TIER	MASTER PATTERN SHELF	PATTERN SECTION	PATTERN TIER	PATTERN SHELF	ORDER NO.
Valve in head Type for 1911 Motor	6	4	9	3/6	A	5	14	AB.	1	8	4365

METAL PATTERN.	DATE	GATING COST	MASTER COST	TOTAL COST	REMARKS
J.W.J.	10/6/10	75.00	55.00	130.00	

SENT TO	DATE	RETURNED	SENT TO	DATE	RETURNED
Erie Fdy. Co.	11/18/10	12/1/10			
Manufacturers Fdy Co.	12/10				

The Foundry

FIG. 1—PATTERN RECORD CARD

prevent you from obtaining the best results. Furthermore, the coke may have a high content of sulphur and ash. Having a good chemist on the job is to be preferred to guesswork when making mixtures of this kind.

Pattern Record and Cost Card Systems

By C. T. Schoefer

THE factors considered when establishing systems of recording patterns in several well-known automobile factories were, first, the rapidity with which a pattern could be found when required and second, how an accurate account could be kept of all patterns issued from the pattern vault and in what manner they could best be located immediately. These requirements made it necessary to establish a more complete system than usual, but the greater care necessary to maintain the system and to keep the pattern in order is insignificant when compared with the time that is often wasted in trying to locate patterns when an incomplete or patched-up system is used.

In Fig. 1 is shown the pattern record card, which is 5 x 8 inches, printed on one side only. The card itself is very complete, as it takes care of everything that might be recorded in connection with the pattern. The patterns are given the same number as the drawings, in fact all parts requiring the manufacture of this piece are given the piece number for various reasons. When the blue print has been completed and checked, it is sent to the cost department, where an order number is given the job, which is entered on the card as shown in Fig. 2, which is the cost card for all tools, patterns, fixtures and machine equipment. The one card is used to simplify matters in the cost department and Fig. 2 shows the side dealing with all labor, while Fig. 3 is the reverse side, on which the material is recorded. On this side of the card provision is made for the material returned, and the total cost, as well as the overhead or shop expense.

All work in the factory is handled by the job number, no name being used, and the material is charged direct to the card, while the cost of labor is figured from the time cards. Whenever metal or gated patterns are made they are given the same job number, with the addition of the letter *M* or *G*, as the case may be, in order to distinguish between metal or gated patterns. The pattern card, Fig. 1, records the various pieces of the pattern and the number of core boxes, also giving the location of the pattern and the master pattern. Thus, each pattern is given a permanent place in the pattern vault and it must always be placed there when out of service.

A record of who made the pattern and the date on which it was made, are also entered for future reference, together with the individual and total costs of the various patterns, a feature that is of value when taking stock. It is also easy to obtain an idea of the life of the pattern and to record the treatment it receives in different foundries, also to note the methods found to give best results in making large complicated patterns, such as cylinders, crank cases, gear boxes, etc. This card system is the result of careful study, and is giving excellent results wherever adopted.

CARD NO. 4365			CARD NO. 436517			CARD NO.		
DATE	AMT. MATERIAL	COST	DATE	AMT. MATERIAL	COST	DATE	AMT. MATERIAL	COST
TOTAL								
SCRAP OR RETURN TO STOCK								
TOTAL MATERIAL								
LABOR								
SHOP EXP.								
COST OF JOB								

The Foundry

FIG. 3—REVERSE SIDE OF PATTERN LABOR CARD ON WHICH IS RECORDED COST OF MATERIAL, LABOR, ETC.

CARD NO. 4365			CARD NO. 436517			CARD NO.		
DATE	PC. WORK	DAY WORK	DATE	PC. WORK	DAY WORK	DATE	PC. WORK	DAY WORK
TOTAL			TOTAL			TOTAL		

The Foundry

FIG. 2—PATTERN LABOR CARD

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication.

COMPOSITION OF NON-FERROUS ALLOYS.

The following specifications for the composition of non-ferrous alloys were issued by the United States Bureau of Steam Engineering, July 1, 1910:

Specifications for Casting Materials.

The composition must be made of such materials as will give the required chemical analysis. Scrap will not be used except such as may result from the process of manufacture of articles of similar composition.

Commercial Brass.

	Per cent.
Copper	64 to 68
Zinc	32 to 34
Iron	2.0*
Lead	3.0*

Muntz Metal.

	Per cent.
Copper	59 to 62
Zinc	39 to 41
Lead	0.6*

Brazing Metal.

	Per cent.
Copper	84 to 86
Zinc	14 to 16
Iron	0.06*
Lead	0.30*

Gun Bronze.

	Per cent.
Copper	87 to 89
Tin	9 to 11
Zinc	1 to 3
Iron	0.06*
Lead	0.30*

Journal Bronze.

	Per cent.
Copper	82 to 84
Tin	12.5 to 14.5
Zinc	2.5 to 4.5
Iron	0.06*
Lead	1.00*

*Maximum.

PHYSICAL REQUIREMENTS OF NON-FERROUS ALLOYS.

The following specifications for the physical requirements of non-ferrous alloys were issued by the United States Bureau of Steam Engineering, July 1, 1910:

Alloy	Minimum tensile strength, lbs. per sq. in.	Yield point, pounds.	Elongation in 2 ins., per cent.
Gun bronze	30,000	15,000	15
Manganese bronze	60,000	30,000	20
Monel metal	65,000	32,500	25
Phosphor bronze	40,000	20,000	20

Method of Casting Test Pieces.

On manganese bronze screw propellers, test coupons should be cast attached to the hub and to each blade, being cast flat on the blade or hub. Those on the blades will be attached at half the distance from the root of the periphery, and may be of any size found necessary to give a sound test specimen. The coupons are to be given no treatment other than machining to reduce them to the proper diameter. For castings weighing over 200 pounds, test pieces or coupons shall be taken in such a manner and from such parts of the casting as will thoroughly exhibit the quality of the metal, not less than three being taken for large propellers.

Monel Metal Test Coupons.

For Monel metal propellers, three test coupons must be attached to the hub. Two will be tested and one retained in case of defect in either of the others. Castings of gun metal, manganese bronze, Monel metal, or phosphor bronze weighing less than 200 pounds finished, may be tested by lots or heat, a lot not to exceed 200 pounds, and a heat 500 pounds of finished castings. Each lot or heat will be represented by one test specimen when attached to a casting or when a casting is sacrificed to obtain a test specimen. If the castings are too small for the attachment of coupons, the test pieces may be cast separately from the same metal. Where test pieces are cast separately from the castings, two test pieces will be required, one to be poured before and one after the castings. Coupons shall be detached from the castings until they are stamped by the inspector. The color of the fracture of the test pieces and the grain of the metal must be uniform throughout.

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

MACHINE-MOLDED PIANO PLATES

As compared with hand-molding, the molding cost has been reduced two-thirds -- Process for casting the pins into the plates

BY the use of a stripping plate molding machine in the manufacture of piano plates, great economies have been effected by the W. W. Kimball Co., Chicago. Not only has the cost of molding been reduced practically two-thirds by the installation of this labor-saving device, but the drilling of the plates and the fitting of the string-supporting pins has been eliminated. An improved product is another important benefit derived from the application of modern methods to this practice, which has not kept pace with the advancement of other branches of the foundry industry in the last decade. That piano plates, owing to their size and skeleton-like frame, could not be successfully machine-molded, was one of the traditions, which until recently, retarded progress in this art. Foundrymen specializing in this line of work were of the opinion that the castings were too thin and of too great area to permit of molding the patterns on molding machines, and, in addition, it was claimed that the skill of experienced molders was required to insure straight, flat castings.

Less than a year ago, the Kimball company decided to erect a foundry for the manufacture of these plates for use in its factory, which has an annual output of 18,000 pianos. The erection and equipment of the plant was placed in charge of Albert A. Huseby, an engineer connected with this concern, and without previous foundry experience. After a careful investigation of the established, hand-molding methods, he concluded that the application of molding machines to this class of work was not impossible of accomplishment and he believed, furthermore, it entirely feasible to cast the pins into the plates, thus obviating subsequent drilling and fitting. For adapting a molding machine to this work, he sought the aid of Henry E. Pridmore, molding machine manufacturer, Chicago. It was decided to mount the pattern on a stripping plate machine and after a number of molds were successfully made in this way, at a greatly reduced cost over hand-molding, Mr. Huseby developed a process for casting the pins into the plates and the equipment for accomplishing this was applied to the molding machine.

The Casting.

One of the plates with the steel pins cast in, is shown in Fig. 8. It will be noted that the casting is cored out to reduce its weight and is well-ribbed to prevent warping. This plate is approximately 48 x 60 inches, varies from $\frac{5}{16}$ to $\frac{3}{8}$ inch in thickness and weighs 133 pounds. For supporting the strings, 135 pins are required, and it is still the customary practice, on hand-molded plates, to drill holes into the casting, into which the pins are driven. Unless the holes are accurately drilled, the pins will not withstand the tension of the strings, and the proper spacing of the pins is also essential to the correct stringing of the wires. The pins are made of soft steel, $\frac{5}{8}$ inch long, and are hammered over to prevent the strings from slipping off. By casting the pins in the plate, all of the previous difficulties have been overcome and, in addition, the pins are more firmly secured than when held by a driving fit.

The stripping plate machine, on which the drag half of the mold is made, is shown in Figs. 2 and 3, the former illustrating the pattern in molding position, and the latter is a view of the pattern dropped away from the mold. The machine is one of the standard types, built by Henry E. Pridmore, which has been equipped with the Huseby device for supporting the pins during the mold-forming operation. Before ramming the mold, the pins are set into openings drilled into the pattern, as shown in Fig. 2. The pins are supported and held in position in the pattern by stools or spindles, clearly shown in Fig. 3 and in the cross-section of the machine, Fig. 7. The stools are $\frac{5}{16}$ inch below the face of the pattern and the

FIG. 1—A FLOOR OF 60 PIANO PLATE MOLDS; THE STRIPPING PLATE MOLDING MACHINE, ON WHICH THE DRAGS ARE MADE, IS SHOWN IN THE FOREGROUND AT THE LEFT, AND THE COPE STAND AT THE RIGHT

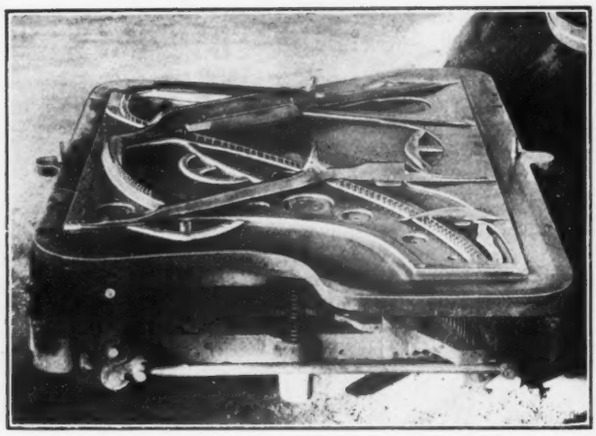


FIG. 2—THE STRIPPING PLATE MACHINE, ON WHICH THE DRAG IS MOLDED; THE PINS ARE SHOWN INSERTED IN THE PATTERN

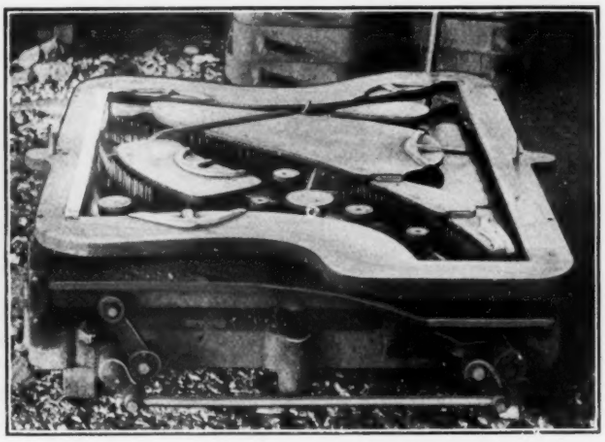


FIG. 3—THE PATTERN LOWERED, SHOWING THE PIN-SUPPORTING STOOLS OR SPINDLES

pins extend this distance beyond the face of the mold, as shown in Fig. 5. After inserting the pins in the pattern, the drag flask is set in position on the machine, filled with sand and rammed. The sand is tamped firmly about the pins as well as other parts of the pattern, and when stripping the pattern away from the mold, the stools or spindles support the pins which are embedded in the sand at their opposite ends. When the mold is lifted off the machine, Fig. 5, the pins are carried in the sand and project into the mold ⅞ inch. The cope half of the mold is rammed on a stand, shown at the right in Fig. 1, and in the foreground, in Fig. 6. After ramming, the mold is merely lifted off this stand, this operation being similar to that usually practiced when molding the drag on a stripping plate machine.

The pins are neither previously prepared nor coated, but are used in the polished condition in which they are received. No difficulty has been experienced from crystallization, as might have been expected when casting molten metal against so small a surface, and the pins are more firmly embedded in the iron than when driven into the drilled openings in the plate. To obviate the burning or crystallization of the pins, the gates have been so arranged that the ribs carrying the pins do not receive the first flow of the hot metal and the iron is poured at a slightly lower temperature than is customary for thin work. Six gates are provided, as shown in Fig. 2, and in the perspective view of the machine and pattern, Fig. 4, and the mold is poured simultaneously from six ladles.

Hand and Machine-Molding Compared.

When made by hand, the daily output of a molder and helper averages from six to seven molds. By the use of the stripping plate machine and the cope stand, five unskilled men produce 65 molds per day, a floor of 60 molds, shortly before pouring-off, being shown in Fig. 1. To equal the record of machine molding would require 18 men—nine molders and nine helpers—when molding by hand. In addition to performing all of the necessary molding operations, the five men set the pins, which is not required of the floor molders. To expedite the machine work, special cast iron flasks have been provided, which carry the minimum amount of sand necessary for making the molds. The flasks are lifted off the stripping plate machine and are rolled over by an air hoist, which is also used for closing the molds. As the foundry has a cement floor, a 1-inch bed of sand is prepared for each mold. A frame, slightly larger than the flask is used for making the bed and the surplus sand is removed with a rake. The duties of each of the crew of five men are clearly defined and the work is specialized as much as possible. Two of the operators are assigned to the drag machine and two to the cope stand, while the fifth man of the gang makes the bed, sets cores and closes and clamps the molds. In making these molds, a large quantity of sand is handled daily by the molding machine crew and one of the heaps in the morning, before the commencement of molding operations, is shown at the left, Fig. 6.

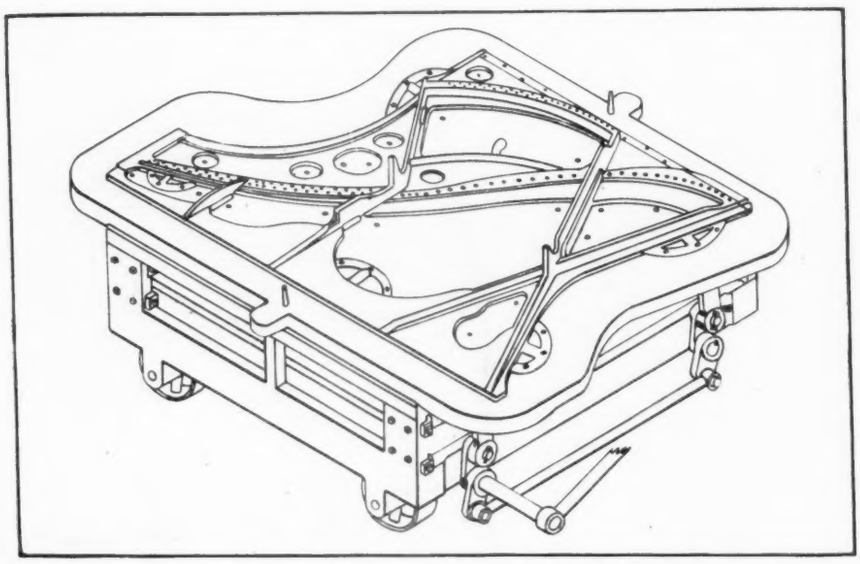


FIG. 4—A PERSPECTIVE VIEW OF THE STRIPPING PLATE MOLDING MACHINE, SHOWING THE OPENINGS IN THE PATTERN, IN WHICH THE PINS ARE INSERTED

A stripping plate molding machine and cope stand for molding larger plates, 50 x 60 inches, and weighing 183 pounds, are now being built by Henry E. Pridmore. The machine will be similarly equipped for casting the pins in the plate, but in addition to the 135 hitch pins in the smaller casting, 45 bridge pins must be inserted.

The Piano Plate Foundry.

The foundry, built by the W. W. Kimball Co. for the exclusive manufacture of piano plates, is 220 x 80 feet, and in

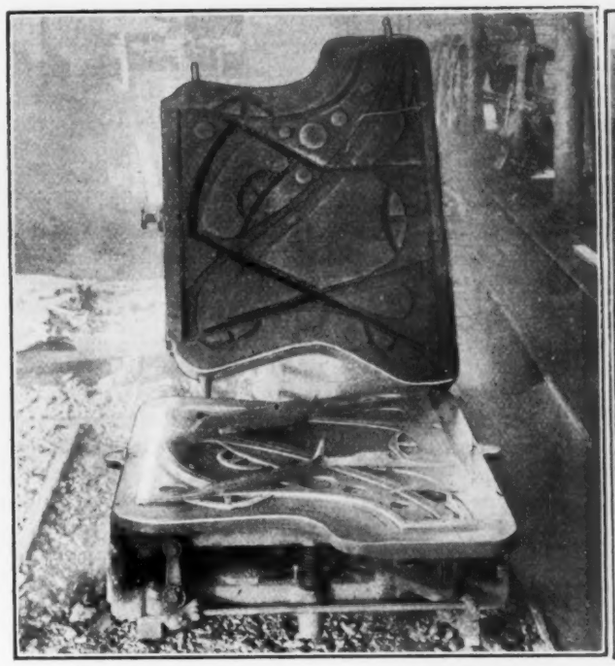


FIG. 5—DRAG HALF OF THE MOLD, SHOWING THE PINS PROTRUDING FROM THE SAND. THESE SOFT STEEL PINS ARE FIRMLY EMBEDDED IN THE IRON

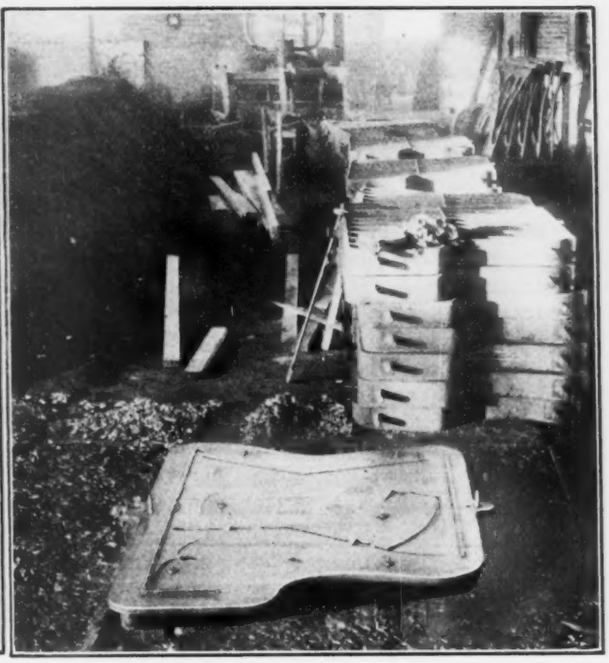


FIG. 6—THE COPE STAND IS SHOWN IN THE FOREGROUND AND IN THE BACKGROUND A PART OF ONE OF THE SAND HEAPS, AS IT APPEARS BEFORE BEGINNING MOLDING OPERATIONS

addition to the molding floor contains a cleaning room, equipped with a sand blast and a finishing department, in which the plates are japanned and varnished. The iron is melted in a 55-inch cupola, lined to 37 inches, installed by the Whiting Foundry Equipment Co., Harvey, Ill., and the blast is furnished by a blower, built by the P. H. & F. M. Roots Co., Connersville, Ind. The blast from the blower is delivered into two branch pipes, the one connecting with the wind belt of the cupola and the other extending outside of the building. Each pipe is provided with a gate to regulate or shut-off the blast and if too much air is being delivered into the cupola, the gate in the other pipe is opened, thereby reducing the volume of air to the furnace. This arrangement permits of the easy regulation of the blast, which is under the control of the melter at all times. No special iron mixture is used other than is ordinarily required for making light castings.

After the castings have been cleaned, they are conveyed to the finishing department on trucks, operating on industrial railway tracks, as shown in Fig. 1. After the japan is applied to the plates, they are permitted to remain three hours in an oven heated to 350 degrees Fahr. After the plates have been removed from the oven and cooled, they are rubbed and varnished and are again placed in an oven heated to 180 degrees Fahr., where they are permitted to remain for two hours. The castings are rolled into the ovens on trucks and after finishing, they are delivered to the warehouse by an electric car, operating in the yard, on the same trucks by which they were conveyed to the finishing department from the casting cleaning room.

Fire Brick for Cupola Linings

By W. J. Keep

Question:—We are undecided whether to use stock brick or cupola blocks for our cupola lining and would like to have some advice on this feature of cupola practice.

Answer:—It requires less labor and fire clay to build a lining of cupola blocks than of stock brick. Furthermore, the block lining will impart a more symmetrical form to the inside of the cupola than an ordinary brick lining, as a cupola lining is weakest at the joints. As there is a smaller number of joints in a block lining, it is, therefore, evident that such a lining will outlast one made of stock brick. Of course much depends upon the material from which the blocks are made and this also applies to the bricks. It naturally follows that fire brick made of good material will out-

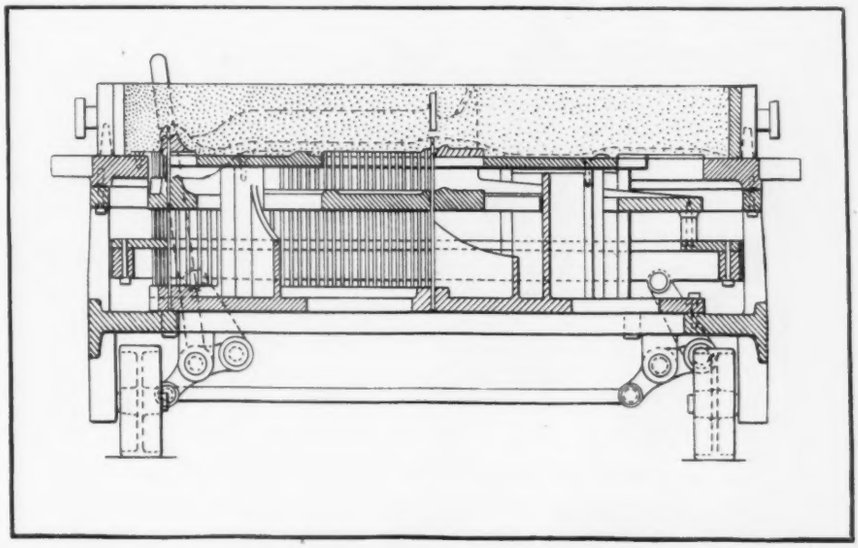


FIG. 7—A CROSS-SECTION OF THE MOLDING MACHINE, SHOWING THE PIN-SUPPORTING STOOLS OR SPINDLES

last cupola blocks made of poor material. We use four different grades of brick in the lining of our cupola. The lining is divided into four sections, angle iron rings being attached to the cupola shell to support the lining above the melting zone, above the charging door, and two additional rings are placed higher in the stack. Owing to the rapid running of our cupolas we reline the sections at the melting zone twice a year. The section below the tuyeres is relined once a year, although occasionally this is done twice annually and the section extending from the melting zone to the ring above the charging door is relined as soon as the bricks are worn away by the settling of the

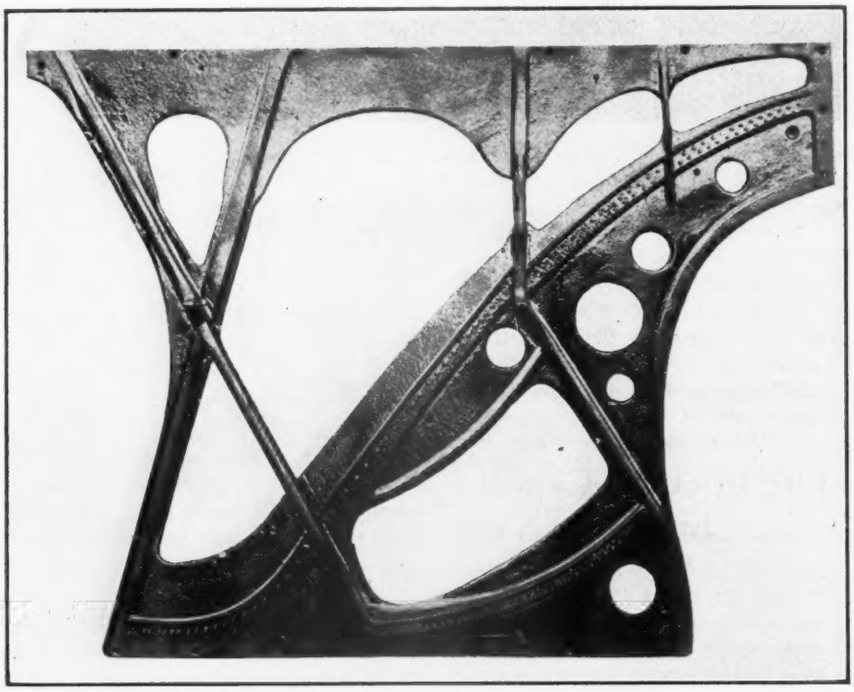


FIG. 8—ONE OF THE PIANO PLATE CASTINGS WITH THE PINS CAST IN

charges, as the heat has little effect on the lining in this section of the cupola. In the selection of your brick you will have to be guided largely by your own experience. In size, stock brick varies considerably, some eastern manufacturers making brick 9 inches long, 4½ inches wide and 2½ inches thick, while some brick made in the west is 8 inches long, 4 inches wide and 2¼ inches thick. As the cupola lining burns out in spots it will be found comparatively easy to remove two or three stock bricks and to replace them with new bricks.

Regarding a double lining, it is advisable to line next to the shell with common red brick of such thickness that will give you the desired diameter after the fire brick lining has been added. If you desire to increase the diameter of the lining, the thickness of the red brick lining can be decreased. It has been our custom to build the inside lining of stock bricks set on end with the sides against each other, using as few arch bricks as are necessary to maintain a true circle. The grout used is very thin so that all of the bricks will touch each other.

Iron Pulley Mixture

By N. W. Shed

Question:—Can you furnish us with the formula for a mixture that will make strong, clean castings, which can be easily machined, will not crack from shrinkage and can be used for cast iron pulleys, having wide faces, as well as for gears? The mixture must be suitable for light, medium and heavy castings. We would like to know the range of silicon, manganese and phosphorus. We do not use any iron in which the sulphur exceeds 0.05 per cent, and most of it averages 0.03 per cent. We use about 500 pounds of our own scrap and 300 pounds of machinery scrap to a charge of 2,000 pounds of iron. What is the content of silicon and manganese in No. 1 cast machinery scrap and railroad cast scrap?

Answer:—Making a strong, soft mixture for light, medium and heavy castings is not an easy proposition. A mixture which would make a light casting strong would make a heavy casting weak. A more reasonable method would be to have one mixture for light pulleys and another mixture for heavy pulleys. For light pulleys, to avoid shrinkage cracks, use about 30 per cent scrap. The pig iron for light work should contain silicon, 2.40 to 2.60 per cent; sulphur, 0.02 to 0.04 per cent; phosphorus, 0.60 to 0.80 per cent, and manganese, 0.60 to 0.80 per cent. For heavy pulleys, you should use more scrap, approximately 45 to 50 per cent. The pig iron should contain silicon, 2.00 to 2.20 per cent; sulphur, 0.02 to 0.04 per cent; phosphorus, 0.50 to 0.70 per cent, and manganese, 0.80 to 1 per cent. If the pig iron is low in manganese, a little spiegeleisen can be added in the cupola, or powdered ferro-manganese can be thrown on the iron as it runs in the ladle. The silicon and manganese in scrap are exceedingly variable. Cast machinery scrap would probably average, silicon, 2 per cent, and manganese, 0.50 per cent. Railroad scrap would probably average, silicon, 1.60 per cent, and manganese, 0.45 per cent.

White Iron

By Richard Moldenke

Question:—We would like to melt a combination of about 85 per cent hard white iron and 15 per cent steel in crucibles and would like to know whether we can use malleable scrap to obtain the white iron which we desire to make. This metal is to be similar to hard malleable and we would like to produce small lots of from 200 to 300 pounds. The castings are not to be annealed.

Answer:—Presumably you wish to use malleable scrap in place of white iron, because this can be more easily obtained. If your product of malleable scrap with steel is to be the same as that obtained from the use of white iron with steel, then with the same proportions you will find only a difference in the total carbon in the product, that is to say by using malleable scrap in place of the white iron in proportions of 85 and 15 per cent, respectively, and not annealing the product, you will get a comparatively softer metal; hence, if your metal is to be used for grinding or such purposes where hardness is an object, it will be better to use 90 per cent malleable scrap and 10 per cent steel so that your total carbon may not run too low. Furthermore, as malleable scrap is liable to be dirty and occasionally slightly oxidized from the previous annealing, a small amount of ferro-titanium added to the charge will be found beneficial. As a general proposition, if malleable scrap is melted under conditions which prevent the silicon from burning out unduly, as would be the case in the crucible process, the castings will have all the properties of white iron and will differ from it only in the content of total carbon, which will be lower.

THE BRASS FOUNDRY

A Modern Steam Specialty Manufacturing Plant

THE production of castings to withstand high pressures, whether water, gas or steam, is always a difficult problem for the foundryman. Regardless of whether the metal is cast iron, steel or bronze, it must possess great strength and density and the molds should be made under conditions as nearly uniform as possible, as regards ramming, gating, feeding, as well as the tempering of the sand. This applies especially to the manufacture of steam specialties, for in addition to the problem of obtaining castings free from hidden defects, the metal is required to maintain its strength under constantly varying, or high temperatures, which may sometimes reach 600 degrees Fahr. Under these conditions, bronze particularly, rapidly loses its strength and the choice of alloys that can be relied upon is limited. Bronze consisting of copper and tin with the minimum amount of zinc and lead, has been found to give the best results. To overcome the many difficulties involved in the manufacture of steam specialties necessitated a large amount of scientific research, and this led the Lunkenheimer Co., Cincinnati, some years ago to install chemical and physical laboratories where the raw materials and finished castings are analyzed and tested, and in addition the various operations involved in the manufacture of castings to withstand high pressures, were reduced as nearly as possible to a science. As a result many novel labor-saving methods have been developed and the company's new plant, at Tremont and Lawnway streets, has been so arranged that they can be carried out with the greatest facility.

The foundry is located on the top floor of this building, and the plan view shown in Fig. 13, clearly outlines the general arrangement of the bench and machine molding floors, the location of the dumping grates, heavy molding floor, core department, overhead trolley system and furnace room. Fig. 1 is a general view of the foundry. In the background is the door leading to the furnace room; on the right are shown the ends of the benches in the core department with the core racks in the center. A broad aisle or gangway, it will be noted, extends through the center of the foundry, and at the left of Fig. 1 are shown the molding floors with the gratings, *A*. Beyond the core racks are the foundry office and elevator. The method of operation, so far as the making of the molds is concerned, is to eliminate the sand problem from the molding floor, which is accomplished by shaking-out the poured-off molds onto a system of gratings which form the gangways of the molding

FIG. 1—VIEW OF ONE SECTION OF THE LUNKENHEIMER CO.'S BRASS FOUNDRY, SHOWING MOLDING FLOORS WITH SHAKE-OUT GRATINGS. THE CORE DEPARTMENT IS AT THE RIGHT

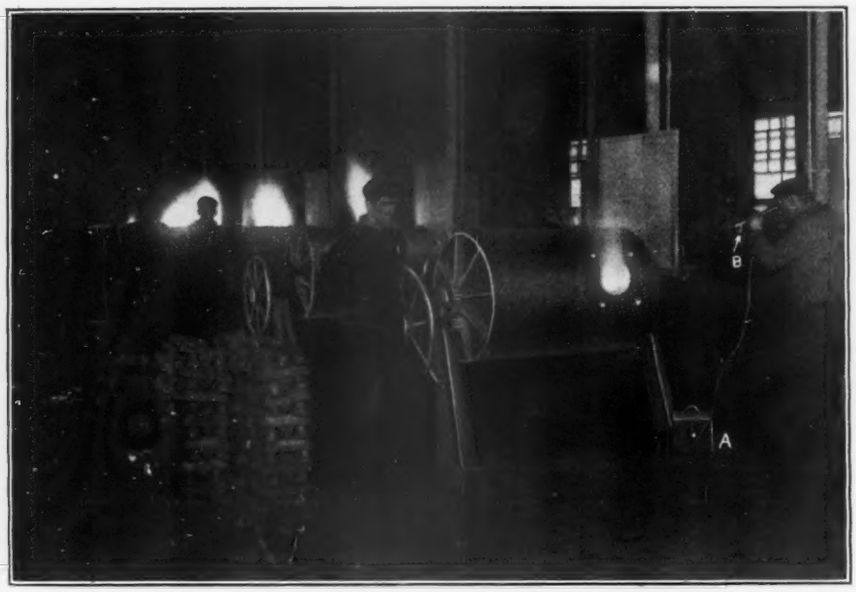


FIG. 2—THE MELTING DEPARTMENT, SHOWING THE OPEN FLAME FURNACES. THE MELTER IS TAKING THE TEMPERATURE OF THE METAL WITH AN OPTICAL PYROMETER

floors. Cool, tempered sand is continually supplied to the molders by belt conveyors leading from the sand mixing plant on the floor below, and as the supply is continuous and ample, the molder, after pouring-off one heat, continues molding without the delay incident to waiting for sand, flasks or floor space. The condition of the sand can also be maintained more uniform and the tempering is under the supervision of one man instead of many. This is a very important point, as lack of uniformity in the amount of water in molding sand is a fruitful source of loss in foundries, not only in defective castings as a result of too much water, but owing to drop-outs and other accidents which occur in making molds, which are due to the lack of moisture in the sand.

Duplicate work, such as standard valves and fittings, etc., is molded on machines which are arranged along the entire length of one side of the molding floor. At present there are 13 molding machines in operation, including ten Tabor machines, two Mumford squeezers and one Berkshire automatic, installed, respectively, by the Tabor Mfg. Co., Philadelphia, the Mumford Molding Machine Co., New York City, and the Berkshire Mfg. Co., Cleveland. These machines are arranged in pairs between the sand conveyors and spouts, and produce from 150 to 275 molds, per machine, each day. Two men, an operator and a helper, are used on each machine and the latter lifts the molds from the machine to the floor, sets the cores and closes and weights the molds ready to pour. The machine men are paid on a piecework basis, and a premium is paid on all molds made in excess of the number fixed as a day's work. Special work and other castings that cannot be profitably adapted to or handled on machines, are made by jobbing molders. The position of the molders is shown in Fig. 9, where *A* is the casing which encloses the sand conveyor and the molder's bench is a shallow bin in front of the conveyor. This bench is at a convenient height for the molder to work comfortably, and all surplus sand falls back to the mixing floor, being guided by the wooden chutes, *B*, Fig. 6.

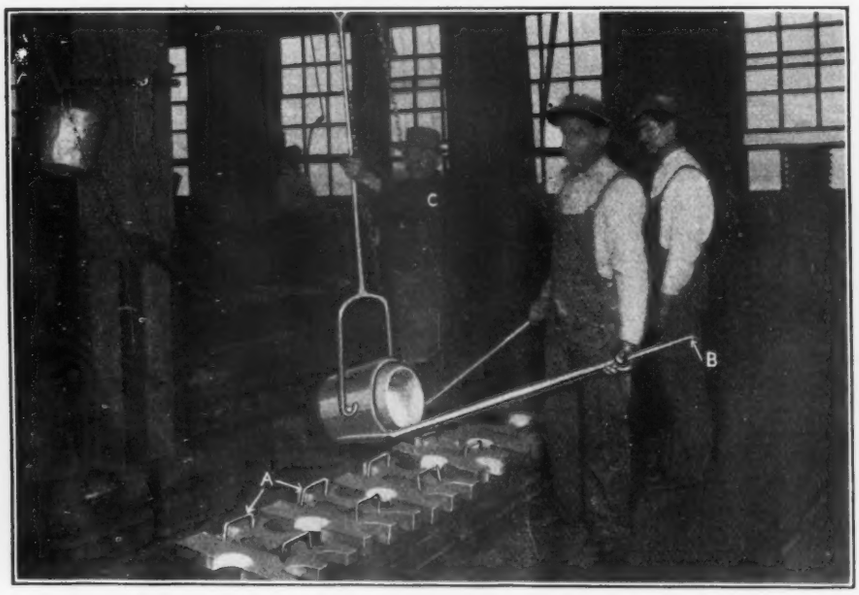


FIG. 3—POURING-OFF A FLOOR OF VALVE FITTINGS. THIS SHOWS THE METHOD OF TILTING THE LADLE WHEN CASTING

Heavy Molding Floor.

The heavy molding floor, Fig. 8, is located in one corner of the shop near the furnace room, as shown in the plan view, Fig. 13. This floor is served by a 2-ton Niles traveling crane, which commands the floor from the wall to the center aisle, and the metal can be brought either by means of the trolley system or by ladle buggies to a point where it can be handled by the traveling crane. Over the heavy molding floor the roof is raised, as shown in Fig. 15, to provide headroom for the crane. At *A*, Fig. 8, the mold for an 8-inch, heavy globe valve is being skin dried, the cope being meanwhile suspended by the crane over a pan of burning charcoal on the drag and in the foreground two other molds containing valves are shown poured-off. The metal used is a puddled semi-steel, which is a special iron mixture developed for high-pressure steam valves by the company's metallurgist. In Fig. 10 is shown a floor of mixed valve bodies and trimmings, the former being made in iron flasks and the latter in snap flasks banded in the drag as shown. The half-barrels are filled with water and are for the purpose of dipping the valve bodies to bring out the color, and the proper time to shake-out is left to the judgment of the molder. The color of a valve body made from a high-grade alloy, rich in tin, and low in lead, is not as brilliant as when made from the cheaper alloys containing less tin and more lead. The molds are all inclined and metal skids are in use for this purpose. These are clearly shown in Fig. 9, be-

ing made of two lengths of steel angles of different sizes, tied together by cross-pieces. Both weights and clamps are used to hold down the copes. The clamps are of the thumb screw variety, as shown at *B*, Fig. 9, while the weights are provided with convenient handles, *A*, Fig. 3.

Melting Equipment.

The furnaces are located in a fireproof room which is formed by partitioning-off the narrow end of the foundry, as shown in the plan, Fig. 13. The metal and other raw material is received on the first floor and is stored in a stock room, from which it is conveyed by elevator to the furnace room, where it is melted in two open flame furnaces, Fig. 2. These furnaces are a modification of the Charlier type, which they resemble in their tumbling barrel appearance. They consist simply of a steel drum lined with firebrick and provided with two circular openings, only one of which is in use at a time, the other being closed with a special brick held by a plate attached to the casing by means of the four bolts shown in Fig. 2. Thus, when one hole is cut away and the lining in contact with the metal is badly worn, the opening is closed with a brick and fire clay, the furnace is reversed and the other opening used, thus greatly prolonging the life of the lining.

Melting Nickel Alloys.

In addition to these furnaces there are also other types, including two Kroeschell-Schwartz furnaces, installed by the Kroeschell Bros. Co., Chicago, and two other oil melting crucible furnaces designed by the company's engineers. These four furnaces are used for melting nickel when making a special alloy used for valve seats. Each of the rotating furnaces are fired with crude oil, and each heat consists of 1,200 pounds of metal, which can be melted in 53 minutes, starting with a hot furnace, but with a cold furnace the best time that has been made is 70 minutes. The average time of each heat, however, is 1½ hours, which includes emptying the furnace of slag and recharging with new metal. This quick-melting reduces the losses, as the metal is not given time to oxidize. The open flame furnaces are mounted on trunnions and one end of each being fitted with a large hand wheel to facilitate tilting. Fuel oil is supplied by a pipe from above, and is sprayed into the furnace through the hollow trunnions on the opposite end to the hand wheel. A shield is also placed at this end of the furnace to protect the operator and oil supply pipe from the heat of the flame which issues from the pouring and charging opening. The furnaces are each 5 feet long and 30 inches in diameter and are arranged as shown in the plan, Fig. 13.

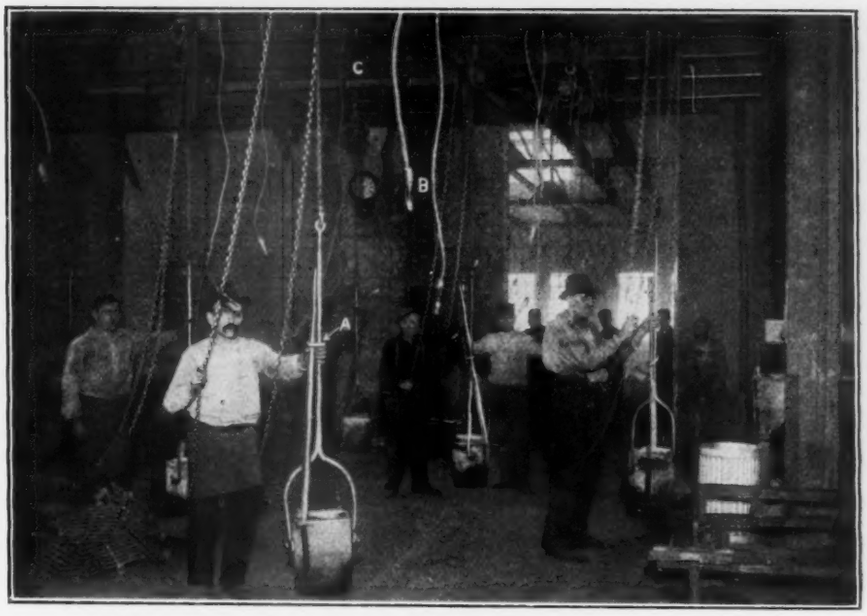


FIG. 4—THE CASTING GANG WITH LADLES FILLED WITH METAL FOR DELIVERY TO THE VARIOUS FLOORS BY THE OVERHEAD TROLLEY. THIS GANG POURS OFF CONTINUOUSLY

Use of the Pyrometer.

The temperature of each heat is uniformly gaged by means of the optical pyrometer shown in Fig. 2. In this instrument the temperature of the furnace is measured by prisms which break up the light emitted into the red rays which are compared with the red radiation from a small electric lamp, the current for which is obtained from the battery box, *A*. The pyrometer, *B*, has the appearance of a telescope, and when directed towards the furnace as shown, the field, as seen through the eye-piece, consists of two semi-circles, one of which is illuminated by the lamp and the other by the furnace. The two semi-circles of light are adjusted to equal intensity by rotating the analyzer, which moves a pointer on a graduated, circular disc and the temperature is ascertained by reference to a table which gives the degrees of heat equivalent to the number indicated by the pointer on the disc. Thus, 74 points or degrees on this disc are equivalent to from 2,400 to 3,000 degrees Fahr. In this

FIG. 5—THE CASTING CLEANING DEPARTMENT

FIG. 6—SAND-TEMPERING DEPARTMENT, LOCATED UNDERNEATH THE MOLDING FLOORS OF THE FOUNDRY. WHEN THE MOLDS ARE SHAKEN-OUT THE SAND FALLS THROUGH THE GRATINGS INTO DEFLECTORS IN THE CEILING OF THIS DEPARTMENT

way a pre-determined pouring temperature is obtained for every heat and guess-work is eliminated.

Many different alloys are used and castings are made of brass and bronze, semi-steel, aluminum, nickel alloys, etc. For high grade steam valves the content of lead in the metal is guaranteed under 2 per cent, as the presence of this metal, while it facilitates machining, is responsible for failures in service caused by wire drawing, etc. The action of steam on non-ferrous metals is so highly corrosive that it is not uncommon for the wedge gate of gate valves to become perforated. Therefore high grade metal is required and a standard formula used by this company is the well-known government bronze, consisting of copper, 88 per cent; tin, 10 per cent, and zinc, 2 per cent. Another mixture used contains copper, 87 per cent; tin, 8 per cent, zinc, 4 per cent, and lead, 1 per cent. The shrinkage of metal in melting is less than 3 per cent, all new metal being used with the exception of sprues, turnings and other returned metal from the machine shop. This scrap is melted in two open flame furnaces and is poured into ingots, the molds for which are of cast iron in the form of elongated ovals with trunnions on either end, by which they are supported on a wrought iron trestle about 18 inches high. When the ingot has set the mold is given a half revolution on its trunnions and the ingot drops out into a sand-filled iron pan underneath, which protects the cement floor from the impact of the falling ingots. There are cement floors both in the melting room and the foundry, and although metal spilling is unavoidable the cement does not explode or flake, as it usually does when laid on the ground.

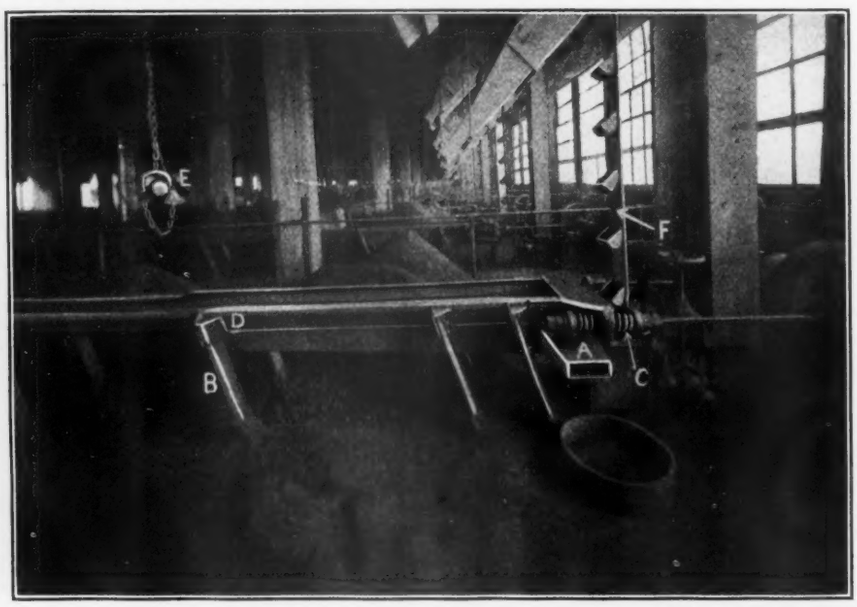


FIG. 7—ONE ROW OF SAND MIXERS IN THE SAND-PREPARING DEPARTMENT

Overhead Trolley.

The overhead trolley system is not extended in the furnace room, but only commands the gangways. The molten metal, therefore, must be conveyed to the trolleys, and this is accomplished by wheeling the pots from the furnaces to the gangways in iron buggies. Thus, when an empty ladle is returned from the molding floors, it is dropped onto a buggy and wheeled to the furnace, where it is again filled and delivered to the trolley. The trolleys carry the ladles by means of the bales shown in Fig. 4. These bales, it will be noted, are provided with a long handle with a loop at the top, into which the hook of the tackle hitches. The metal is delivered to the molding floors by a trolley system provided at each intersection of the main and auxiliary system with a turntable switch, which operates only one-quarter turn, delivering a ladle crane from the main track to the side track, and vice versa. Crane carriages are allowed to go in one direction only on the main track, all ladle cranes being run from the melting department onto the right track and back on the left track. However, at any switch a ladle can be transferred from the right track to the left track for return to the melting room. These switches are revolved by cords, *B*, Fig. 1, the handles of which are hung within easy reach of the operators. These tracks are so arranged that the ladles can be delivered to the molds, which are in turn placed close to the gratings. In the melting room the ladles are lowered onto ladle trucks that carry them to the furnaces. By this overhead trolley system, ladles full of metal are quickly conveyed from the furnaces to the molds. In the melting room but one turntable switch is provided, all ladles being run to the end of the track and are switched over for their return on the other side.

Fig. 3 shows a floor of valve fittings being poured-off. The ladle is suspended from the trolley by means of the bale and is tilted by the lever,

B, which is riveted to the side of the ladle, so that when the trolley lever is pulled towards the caster, the ladle revolves on its trunnions in the bale sockets. The tackle is manipulated by the operator, *A*. Fig. 4 is a view of the casting crew, which forms one unit in the division of labor. The ladle is held in position, while in transit, by means of the ring, *A*, Fig. 4, carried by the bale handle and which is slipped over the tilting lever, *B*, Fig. 3. The section of the track extending into the furnace room is also shown in Fig. 4, as well as the turntable cables, *B*. When the molds are sufficiently cool they are shaken-out by being dumped onto the gratings which form the gangway between the molding floors. A view of these gratings is shown at *A*, Fig. 1, and the sand passes through the openings to the floor below, while the castings remain on the gratings. The castings for trimmings are not dipped for color, as they must be machined. These castings are removed from the gratings and are piled on four-wheeled trucks, by which they are delivered to chutes through which they drop into bins on the floor below. Five power sprue cutters are used to remove the sprues, gates, etc., from the small work. After the removal of the gates and sprues, the castings are taken to the sand blast cleaning department. All castings, such as valve and lubricator bodies, are hand-cleaned on the inside only by a sand blast gun. All other parts are sand-blast cleaned in four Paxson-Warren sand blast tumbling barrels, installed by the J. W. Paxson Co., Philadelphia. All grinders are equipped with a suction exhaust that removes all dust and dirt from the room. No water tumblers are used, as it has been found that this tumbling action hammers the scale into the metal so that tools in the machine shop do not take hold with the same ease as when the castings have passed through the sand blast tumbling barrels in which the scale has been removed. After being cleaned and ground the castings are inspected, weighed and are delivered to the rough stock room, from which they are delivered to the finishing department as required.

Testing.

In the finishing department the castings are first subjected to a hydraulic test, and the pressure applied for high pressure valves ranges from 200 to 1,000 pounds. If the castings successfully withstand this test they are passed through the cycle of operations which terminates in the finished valve, and if defective they are returned to the foundry. The loss from defective castings is less than 6 per cent on high pressure work, which includes leaky castings. On ordinary valves the percentage of loss from defective castings is 2.70 per cent. This average, however, is kept low by including such work as oil cups, grease cups, trimmings, etc. These averages do not represent the best records that were made when the shop was small and hand-work prevailed entirely. Then the percentage of loss was frequently as low as 2.50.

When the molds are shaken-out the molding sand falls through the gratings to the floor below, where it is mixed and screened, being returned to the molders by conveyor belts shown at *F*, Fig. 7. Directly underneath the gratings, which form a part of the ceiling of the fourth floor, are the vibratory sand mixers shown in Fig. 7. The sand, however, does not fall directly into the mixers, as it must first be sprayed with water and cooled. It is, therefore, deflected into aisles at the sides of the mixers, and enough sand is provided to carry on the work for two days, so that the hot sand is not used until the following day, thus giving it a chance to thoroughly cool. The deflectors, shown in Fig. 6, are situated directly underneath the gratings in the gangways of the molding floor. The deflectors are long steel plates, hinged on the

FIG. 8—A VIEW OF THE HEAVY MOLDING FLOOR

FIG. 9—VIEW OF ONE OF THE MOLDING FLOORS AFTER SHAKING-OUT

FIG. 10—THE VALVE MOLDING FLOOR

principle of a butterfly valve. In Fig. 6 the deflector in the foreground is set so as to throw the sand away from the first gangway, and it is held in this position by a weight suspended from a chain, as seen at *E*, Fig. 7. When the sand falls into the aisle at the side of the tempering trough it is first sprayed with water. An experienced man is in charge of this operation, as the amount of water used must be carefully gaged. The sand in which heavy castings have been molded requires more water than that used for light work. An effort, however, is made to keep the moisture between 8 and 11 per cent. To accurately determine the proper degree of moisture, a sample of sand is tested in the laboratory each day.

After the sand has been sprayed it is shoveled into piles, as shown in Fig. 6, and in due time is filled into the mixers, where it is screened and eventually again reaches the molders. There are 21 vibratory sand shakers in this department, as shown in Fig. 7. Eighteen of these power shakers are at present in operation. They are merely U-shaped troughs, deeper at one end than the other. In the deep section of the trough which extends from *D*, Fig. 7, to the end, a screen is placed on a level with the bottom of the shallow end of the trough. The sand can be thrown into any part of the trough and will travel toward the screen. The same movement also discharges the riddled sand into the conveyor buckets from the open end of the compartment under the screen. This is accomplished by a vibratory, reciprocating movement produced by two eccentrics attached to a shaft driven by a pulley. The trough is supported by a number of inclined, flexible hardwood legs, which, when the trough is pulled toward the pulley end, cause it to rise about ¾ inch, thus producing a movement which causes the sand to always travel toward the screen. In Fig. 7, *A* is the spout through which the screenings are carried to the sieve on the floor from which they are thrown into receptacles to be carried to the metal separating room. The screened sand falls into the lower compartment underneath the screen and travels from the open end into the conveying buckets, which carry it to the floor above. There it is dumped into bins which are open on both sides of the conveyor, and deliver the sand to the molder. In Fig. 7, *BB* are the flexible hardwood trough supports, *C* the springs that absorb the shock caused by the thrust of the eccentric rod, *E* the deflector weight and *F* the conveyor belts.

FIG. 11—THE CORE DEPARTMENT

Core Department.

The core department is at present located in one corner of the main floor, a view of which is shown in Fig. 11. Three double core benches are provided and the core ovens are located at the ends of the benches. The core-oven equipment consists of a battery of eight Millett ovens, *A*, Fig. 11, and a large truck oven, *B*, Fig. 11, for heavier work. Ample illumination is provided by the windows in the saw-tooth roof and at night a number of mercury vapor lamps are used. Silica sand is largely used for making the cores. It is bonded with core oil in the proportions of one of oil to 50 of sand. The cores are all made in one piece without either wires or spurs through the seats. They are vented from end to end, and are sufficiently strong to withstand the pressure of the metal. Dryers are used and are essential in making valve cores in this manner. The core room and core ovens will ultimately be located on the floor below the foundry and it is planned to later install 42 additional molding machines in that section of the foundry vacated by the core department, and the floors at present occupied by the jobbing molders. The ovens are gas-fired and after the cores are baked they are stored on the metal core racks shown in Fig. 1.

The building is of reinforced concrete construction somewhat triangular in shape, five stories in height, 300 feet long and varying in width from 83 to 134 feet. Near the narrow end of the structure a spur track cuts through the building on a curve, on one side of which is located the chemical and physical laboratories and on the other the time-keeper's office and employes' entrance. The building is well lighted, containing over a thousand windows, which are fireproof both frame and sash being made of pressed sheet steel treated to prevent corrosion. The foundations rest entirely on concrete piles, 20 inches in diameter, which are arranged in nests of five and six piles and are headed with concrete, 12 inches thick and 8½ feet in diameter, on which the column bearings rest, as shown in the cross-section of the building, Figs. 14 and 15. The upper floors are carried on reinforced concrete columns, varying in size from 20 x 20 inches to 24 x 24 inches, and spaced on 21-foot centers lengthwise of the building and on 14½-foot centers crosswise of the building. There are 70 supporting columns on the first floor, exclusive of those in the walls or partitions proper. Fig. 14 is a cross-section through the wide end of the building between the first and second rows of supporting columns, and shows the construction of the floors, the foundations and the roof. The second, third and fourth floors are all supported by columns spaced as on the ground floor, the size of which progressively decrease by 2 inches each dimension for each floor.

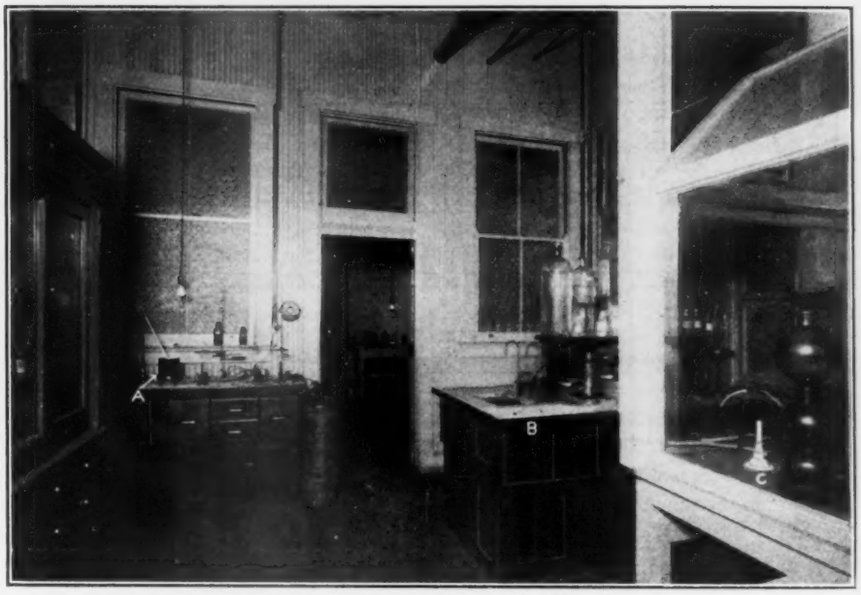


FIG. 12—VIEW OF ONE CORNER OF THE CHEMICAL LABORATORY

The foundry is on the fifth floor and is lighted by the saw-tooth roof shown in Figs. 14 and 15. Each tooth is topped with 24-inch, conical ventilators, fitted with butterfly dampers. The horizontal supporting beams for the second, third, fourth and fifth floors are all 18 inches deep and 5½ inches wide, with a clearance of 11 feet 8 inches, under the second and third floors and 12 feet under the fourth and fifth floors. The narrow end of the foundry is partitioned-off with a fire wall, which is fitted with a fire door, thus affording protection in case of fire and keeping most of the heat out of the molding room in summer. Fig. 4 is a view from the molding room into the furnace room and shows both fire wall and doorway. On the fourth floor is the sand-tempering plant and the casting cleaning department. The third floor contains the pattern storage and at one end a number of the automatic screw machines are located. On the second floor are the stock rooms and brass finishing departments and on the first floor are located the laboratory, time-keeper's office, shipping department and warehouse.

Fig. 12 is a view of one corner of the laboratory, showing the electric induction furnace table, with a small experimental furnace at *A*, which is operated from an incandescent lamp socket and at 220 volts generates up to 3,000 degrees of heat; at *B*, Fig. 12, is the

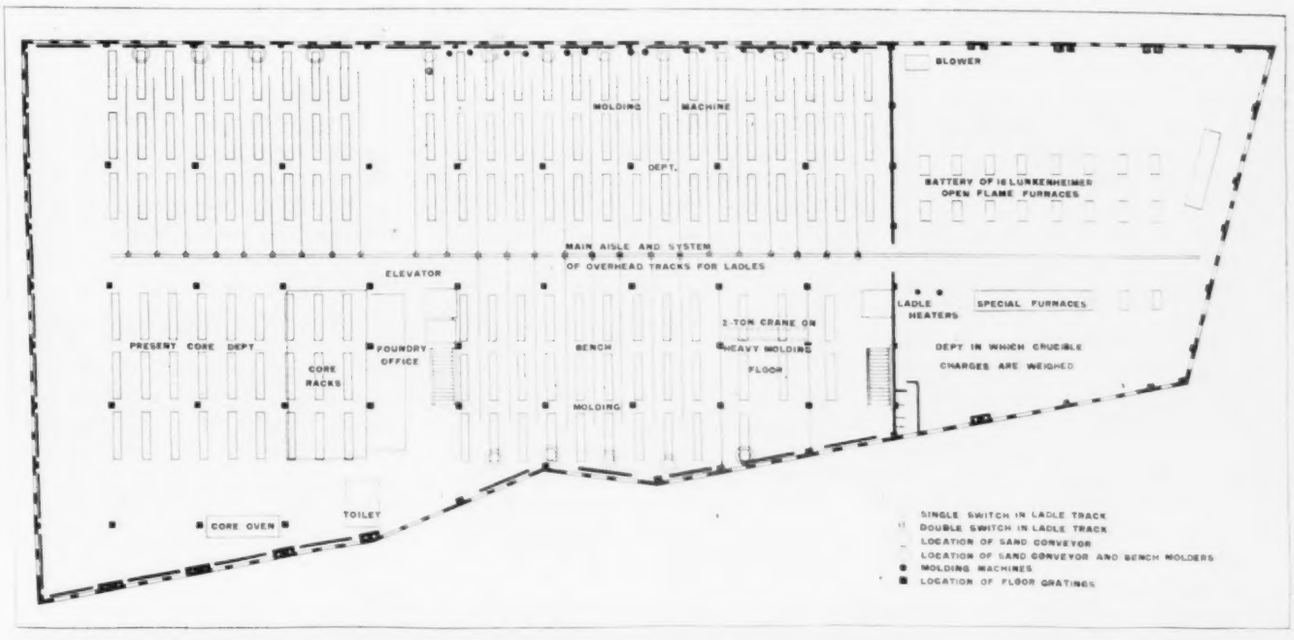


FIG. 13—GROUND PLAN OF THE FOUNDRY LOCATED ON THE FIFTH FLOOR OF THE LUNKENHEIMER CO.'S NEW PLANT

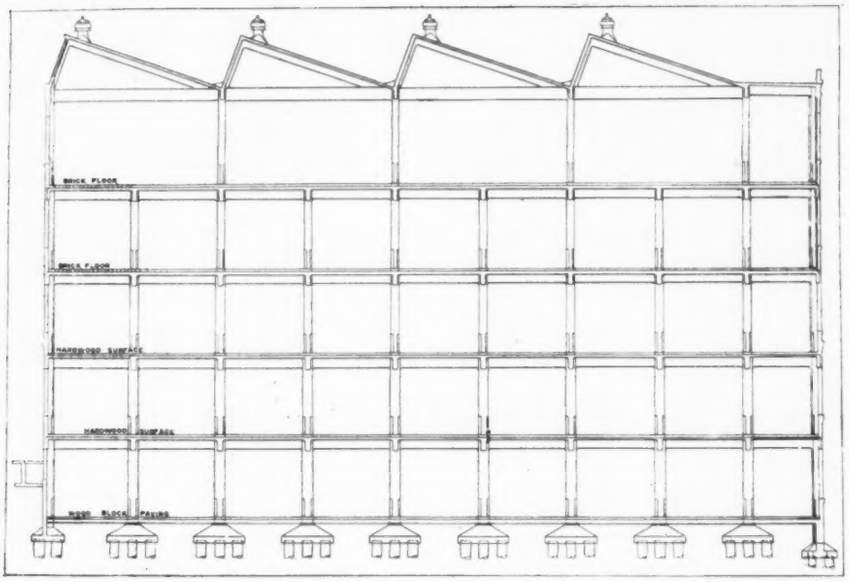


FIG. 14—CROSS-SECTION THROUGH THE WIDE END OF THE LUNKENHEIMER CO.'S PLANT

table for iron analyses and at *C* the burners under the exhaust hood. George K. Elliott, well known for his researches in high pressure steam metallurgy, is the chief chemist of the Lunkenheimer Co.

The unusual features of this plant are the isolation of the furnaces in a separate room, the novel methods of melting, handling and transporting the metal, and the efficient and economical sand-handling arrangements. The entire arrangement of the plant was based on the best and latest foundry practice in both this country and Europe and much of the interior equipment was designed and built by the Lunkenheimer Co. The buillding was designed and constructed by Bert L. Baldwin & Co., engineers, Cincinnati.

Improved Nickel-Plating Methods

By H. J. Hawkins

Plating, contrary to the belief of some who do not understand the process, especially nickelplating, will not cover a "multitude of sins". Every defect in the base metal, such as pin holes and scratches, will show more plainly, if possible, when plated and finished than before. Therefore, good results do not depend entirely on the plater and his department; each operation must be properly performed, and if this is done the plater's difficulties will be lessened.

There is some honest difference of opinion as to whether some of the new formulae for nickel solutions will actually give better results than the old, standard solution made up from double nickel salts—sulphate of nickel and ammonia—using about 12 ounces per gallon of water, or enough to bring the solution up to 7 degrees Baume. While this formula has met our requirements for many years, with slight variations to adapt the solution to the particular work at hand, and is still being used and giving good results, yet, most of the younger school of platers who are constantly on the lookout for novel and improved methods, have left the old, "one ingredient" formula for one, while it is more complex, that imparts a snow white deposit on "back ground and dead white work." The deposit is soft and pliable, being easily brought to a high finish under the buffing wheel. It also adheres tenaciously to the base metal, seldom, if ever, blistering or peeling if the work is properly cleaned.

Nickel-Plating Solution.

The deposit from this solution, not being of a brittle nature, stands bending and forming better than does the deposit obtained from the ordinary solution. The formula for this solution follows:

Water	1 gallon
Double nickel salts	8 ounces
Sal-ammoniac	2 ounces
Boracic acid	¼ ounce

Boracic acid has come to be a standard remedy for nickel solutions and is carried by all plater's supply houses. This acid is useful in that it seems to give conductivity to the solution, whiteness and toughness to the deposit, and will reduce the surplus of free ammona that may be present without in any way damaging the solution. Boracic acid, being mild and harmless, so far as the nickel solution is concerned, is used to reduce the free alkali and give tone and color to the deposit.

Frequently, double nickel solutions

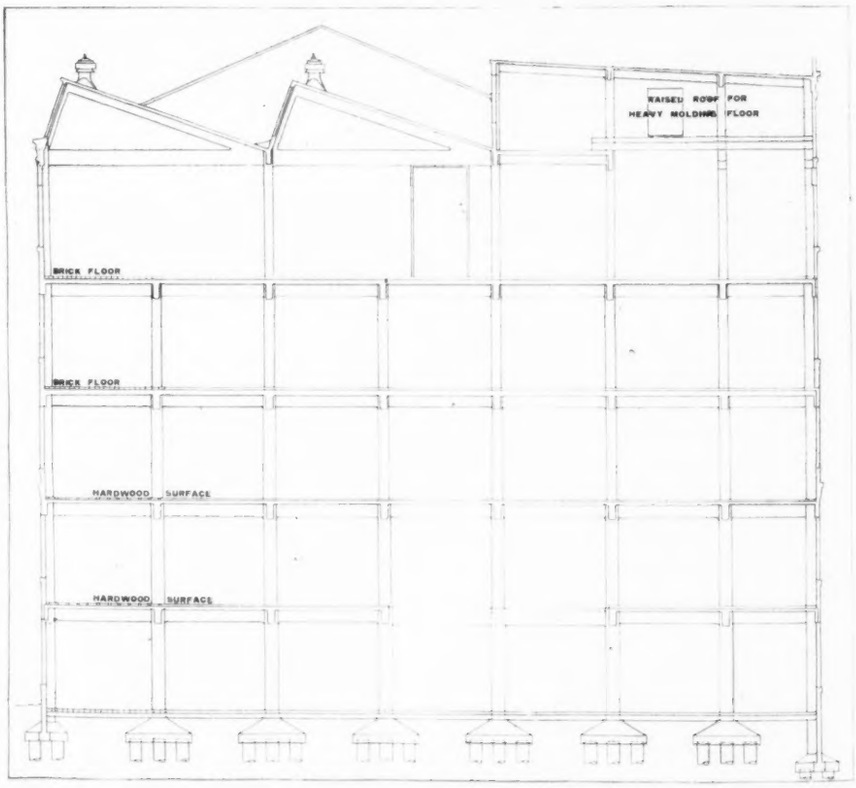


FIG. 15—CROSS-SECTION THROUGH ANOTHER PART OF THE LUNKENHEIMER CO.'S PLANT SHOWING THE RAISED ROOF OVER THE HEAVY MOLDING FLOORS

become impoverished in metal, and consequently too alkaline, owing to the fact that the nickel sulphate has been withdrawn, leaving the sulphate of ammonia, which, while not aiding in the deposition of metal, enhances the specific gravity of the solution. Therefore, many neglected and hard-worked solutions, which may show 7 to 8 or even 10 degrees Baume and are supposed to be high in metallic salts, are really impoverished and it is the excess of sulphate of ammonia which causes this record to be made on the hydrometer. In this particular case of impoverished solution, single nickel salts are the most efficient and desirable remedy, because they contain twice the amount of metallic nickel salts contained in the double salts, being composed of sulphate of nickel and sulphuric acid.

The immediate result of adding single salts to a worn-out nickel solution is to add new metal in the simplest and quickest manner, and at the same time the free acid given off by the single salts reduces the excess amount of free ammonia and results in forming double salts of nickel and ammonia, which is the end in view.

Single nickel salts are being now more generally used. A few years ago they were used sparingly and only as a remedy for sick solutions. However, today, many large plating rooms consume as large or an even larger amount of single salts than double salts. In fact I know of one large plant, operating 8,000 gallons or more of nickel solution, which uses the single salts exclusively for feeding its solutions and the finished product of this plant proves the wisdom of their use. However, the only object of adding metals to the solution is to keep it in the best possible condition to give good results.

If the plater will keep his tanks well filled with good, soft nickel anodes, so that the surface is equal to or greater than the cathode surface,—in fact the anode surface can hardly be too great—and where the tanks are kept busy, if he will keep plenty of anodes in the tanks and takes the trouble to clean them occasionally, he will find that it will not be necessary to use such a large amount of salts to maintain his solutions at the proper density.

Proper connections, and wire of sufficient carrying capacity, are given too little attention by platers. All connections should be tight and clean, and the wire leading to the tank should be known to have sufficient carrying capacity to insure a free passage of current without heating. Excessive heating in the connections and in the wires leading to the tank indicate insufficient carrying capacity, and should be remedied.

The accompanying table has been prepared for the guidance of platers when making connections to plating tanks. It gives the various sizes of main conductors required to carry a given number of amperes different distances from the dynamo to the tanks.

	Distance in feet from dynamo to tanks.			
	15	20	30	40
Amperes.	Diameter. Inches.	Diameter. Inches.	Diameter. Inches.	Diameter. Inches.
50	1/8	1/4	1/4	5/16
100	1/4	5/16	3/8	3/8
200	3/8	3/8	1/2	7/16
300	7/16	1/2	5/8	11/16
400	1/2	5/8	11/16	13/16
600	2 x 1/4	2 x 1/4	2 x 1/2	2 x 1/2

Brass Foundry Difficulties

SOLVED BY EXPERTS

Trolley Wheels

We would like standard formulas for high and a medium grade trolley wheel metal. We have made a large number of trolley wheels, but have experienced considerable difficulty in producing satisfactory castings.

The difficulty experienced in obtaining an entirely satisfactory formula for casting trolley wheels, is due to the fact that the requirements of service demand a very stiff, soft metal of high electrical conductivity, and thus far no such alloy has been discovered. If the entire wheel is cast in soft copper of high electrical efficiency, the flanges of the wheel are so soft they are battered over sideways the first time the trolley jumps the wire and strikes a span. Then the wheel cannot revolve, as the spread flanges will not pass through the harp. Consequently the wheel slides and is rapidly cut through in one place, or if seen in time, a deep cut is made that spoils the wheel for further service. On the other hand, a wheel stiff enough to withstand the abuse without bending at the flanges, is necessarily hard, and is a poor conductor. It is liable to spark, which causes little pits and pimples that rasp the trolley wire like a file. A hard wheel, therefore, is to be avoided, because it is more expensive to renew the wire than the wheels. For this reason a medium hard wheel has been found to give the best service, all things considered, and a formula which we have used extensively, follows: Copper, 89 pounds; tin, 6 pounds; zinc, 5 pounds. Another excellent alloy is copper, 95 pounds; phosphor tin (5 per cent), 5 pounds. This alloy, without the phosphor, is liable to develop pin holes and will prove too soft. A large percentage of the wheels, thus made, bent over on the flanges, and to increase the hardness the phosphorus was added, although the conductivity was thereby lowered.

For a medium grade mixture use copper, 82 pounds; zinc, 14 pounds; tin, 4 pounds. Lead should be omitted from trolley wheel alloys, also manganese, but zinc, though a volatile metal, is not objectionable.

Aluminum Bronze

We have been making 9 per cent aluminum bronze castings, but cannot obtain them free from dross. Can you suggest anything to prevent this trouble? Would you advise silicon-copper or phosphorus as additions?

There is a possibility that the addition of magnesium would help you and we suggest that you make a trial of this by alloying one-fourth of 1 per cent of magnesium with the aluminum bronze. To do this it is advisable to first alloy the magnesium and aluminum and then add this combination to the melted copper in the usual way. Magnesium, however, is much lighter than aluminum and has a greater hardening affect on the copper. Therefore, use only 8 per cent of the alloy of magnesium and aluminum instead of 9 per cent aluminum. Neither silicon or phosphorus will be of any value to prevent drossing when casting aluminum bronze. Silicon causes drossing but is not as active in this respect as aluminum. While the general effect of silicon and aluminum when added

to copper is the same, the former is more expensive, as a relatively large amount of silicon-copper must be used in order to introduce sufficient silicon to harden the copper. Thus, 10 per cent of silicon-copper containing 10 per cent silicon, when added to copper does not materially harden it. Careful attention should be given to the manner of gating when casting aluminum bronze and the metal should always enter at the bottom of the mold through an opening larger at the point where it joins the casting than where it is attached to the runner. Two gates should never impinge and care should be exercised to avoid agitation of the metal, either while entering the mold or after it is cast, to prevent the formation of dross. It will also be necessary to place large risers over all heavy sections of the casting.

Porous Castings

We make a specialty of castings for water works, which have to withstand a hydraulic pressure of 200 pounds, and are troubled with leaks in the castings, apparently caused by porosity. Can you tell us the probable cause of our difficulty?

Defects in brass castings, such as porosity, hidden dross, etc., resulting in leakage under pressure, generally originate in the furnace, consequently, when trying to locate the source of such troubles, particular attention should first be paid to the manner in which the metal is being treated while it is being melted. If the copper or brass is simply charged into the crucible and allowed to melt without attention, more dross or oxide will be created and dissolved than when it is assisted in settling down by being pushed or kneaded at intervals, irrespective of whether charcoal is used or not. This does not mean that the furnace man should be continually poking at the charge, as this will retard the melting, and is only necessary when the projecting pieces of metal have become so soft as to be in danger of wilting, which should always be avoided. All that is necessary is to charge the cold additions of metal on top of what is already in the pot, whenever it has sunk sufficiently to permit this, and the weight of the newly charged material will continually press the heated portion down into the fluid metal in the lower part of the crucible, where it is protected from further oxidation by the covering of charcoal. The fires, therefore, will need continual attention, and that explains why a conscientious furnace tender is the best insurance against porosity and similar difficulties. Crucible rings are also to be recommended, because they act as a feeding hopper, and being continually filled with cold metal, exert a constant pressure on the charge below, forcing it down as it becomes softened by the heat, thus greatly lessening the possibility of oxidation.

Oxidation, even when it does not cause porosity or sponge-like holes in a casting, produces dross, which is carried into the mold, and deposited where the shape of the casting is favorable to its retention, and, although often externally invisible, it forms a porous path through which leakage may occur. It may be overcome, to a certain extent, by deoxidizing the alloy, and for this purpose phosphorus can be recommended, but if the melting is not properly performed in the first place, more or less trouble will always arise, regardless of what may be later done to remove its bad effects. The alloy also may be at fault, as it may contain too much lead. The following alloy has been found good for work of the class mentioned: Copper, 89 per cent; tin, 5.50 per cent; zinc, 3.50 per cent, and lead, 2 per cent. A small quantity of phosphorus can be added, if thought necessary. For special castings to withstand high pressures, an excellent mixture follows: Copper, 90 per cent; phosphor-tin (5 per cent), 5 per cent; tin, 5 per cent.

Ventless Cores

We have an order for brass castings that require an intricate core and on account of the difficulty of taking off the vent, find ourselves greatly handicapped in turning them out, as the molders have to wait on the coremakers. We have, therefore, made several trials of different core mixtures with a view of producing a ventless core, that would not blow, but have met with but poor success.

The ventless core, to a large extent, must be considered a foundry myth. Some coremakers use ordinary molding sand for so-called ventless cores and claim results that, unfortunately, no one else can achieve. Some coremakers mix a small amount of molasses water with the sand, but this is of doubtful value, as gas is generated and has to pass off, so it generally takes a short cut through the metal, leaving a hole behind. The same can be said of glue, dextrin, starch, flour and oil, so it is generally found necessary to vent, and this is the safest way out of the difficulty. Unless a sand can be obtained that does not require a binder, some glutinous substance will have to be used, in which case gas will be generated and will play havoc with the casting if it cannot pass off. If no vents are provided, the substance of the core itself will have to be so porous as to be self-venting, and to obtain this condition it will be necessary to mix some substance with the sand to make it exceedingly open. Ashes are best for this purpose, but not the kind that drop through the grate, but the fine substance that is carried off by the furnace gases and is removed from the boilers of steam plants, using soft coal for fuel. The ashes are dark, reddish brown in color and resemble sand in appearance. They are exceedingly porous and light, and if mixed with core sand up to 50 per cent, render it self-venting when a linseed oil core compound is used as a binder. Some large power plants produce several wagon loads of these ashes per day, so there should be no difficulty in obtaining them. You might also try binding these ashes with silicate of soda, using no sand. The latter is merely a suggestion and has not been tried out.

Manganese Bronze Borings

A recent purchase of brass borings we believe contained some manganese bronze chips and we would like to know if there is any way by which this material can be detected from brass or composition borings, other than by analysis.

If the manganese bronze is mixed with composition or brass turnings there is no way by which they can be separated, even if their presence is positively known. The only method of using them is to melt the turnings and cast the metal into ingots, or to run the turnings direct into castings where the quality of the metal is immaterial. The manganese bronze turnings will only cause trouble when they contain aluminum, as is usually the case with cast manganese bronze. Forged manganese bronze is generally free from aluminum and such turnings, when remelted, can be added to either red or yellow brass without causing trouble, providing discretion is used as to the amount added. When melted alone, however, the percentage of zinc may be sufficiently high to interfere with their casting qualities and the castings may be black and misrun. There are exceptions to this rule, however, as an alloy of 58 per cent copper and 42 per cent zinc, deoxidized with small percentages of iron or manganese, will run fine cast-

ings without the addition of aluminum. If the castings are black and misrun, the addition of 5 ounces of aluminum to 100 pounds of the alloy will be found ample to permit them to be used in small castings made from yellow metal, such as refrigerator trimmings and other small, cheap hardware.

Cast manganese bronze turnings can, of course, be used, but they will cause considerable trouble if mixed indiscriminately with red brass or bronze for machinery castings, and it will be better to run them into small ingots after the iron has been removed by running them through the separator. The ingots should not be heavier than 5 pounds each, and as the content of aluminum will determine the quantity that can be used in each heat, it is advisable to begin by adding one 5-pound ingot to 100 pounds of red metal, at the same time reducing the zinc in the mixture about 2 per cent. If the aluminum does not show, the manganese bronze ingot metal may be increased to 10 pounds. This will be the case if the quantity of aluminum it contains is not more than one-half of 1 per cent. Cast manganese bronze turnings can be detected by melting a small amount of these chips and running a test bar, which will show if aluminum is present, or if the metal possesses casting properties. Another method of identifying them is to heat a sample red hot and quench it in water, when the characteristic pale gold color of this alloy will develop.

Gas Stove Burners

We are large manufacturers of gasoline stoves and are having trouble with our brass for the burners. The alloy we are using is a mixture of copper, 80 per cent; zinc, 14 per cent; lead, 5 per cent, and tin, 1 per cent. This alloy is readily machined, but the perecentage of porous castings is high. We are using salt for a flux and cover the metal with charcoal. We put the burners to a test of 50 pounds pressure. Will you kindly let us know what to do to overcome the leakage?

The mixture given is too high in lead to withstand high pressures, but betore changing the formulas it might be well to try the effect of deoxidizers, of which there are only two that are suitable for this class of work. They are phosphorus and manganese, and we suggest that the latter be tried first. Try worn out dry batteries and use at first two to each 100 pounds of metal, charging one battery with the cold metal and another when the alloy is melted. The contents of the second battery should be removed and mixed with an equal amount of powdered charcoal. This is scattered onto the surface of the metal as soon as melted, and when heated through, should be stirred in thoroughly. The manganese will be reduced from the oxide in the batteries, and will probably color the castings a dull brown. Should this be objectionable use only one battery, but try for the brown color first, to be sure of thorough deoxidization by the manganese. If the castings, when tested, still leak, the manganese is ineffective in this alloy and phosphorus should be tried. If yellow phosphorus is used, add about 2 inches to each pot, dropping it onto the metal, stirring it in; 15 per cent phosphor-copper is, however, much to be preferred. At first, try 4 ounces to 100 pounds of metal, and if not satisfactory, increase to 8 ounces. If this does not effect an improvement, it can be regarded as a failure and a change of mixture is advisable. In this event we suggest a trial of the following: Copper, 80 pounds; zinc, 15 pounds; lead, 3 pounds; tin, 2 pounds; phosphor-copper, 4 ounces, or a straight yellow brass, as follows: Copper, 73 pounds; zinc, 22 pounds; lead, 3 pounds; tin, 2 pounds; but if a little extra cost of the metal is unimportant the following is better: Copper, 85 per cent; zinc, 10 per cent; tin, 3 per cent; lead, 2 per cent.

Gelatine Molds

We understand that wax models or patterns used in figure casting by the so-called lost wax process, are frequently cast in gelatine molds, and we cannot understand how it is possible to do this and not melt the gelatine. What kind of wax is used in this process? Our experience has been that pure beeswax shrinks so much that the castings split.

Considerable experience is necessary in order to successfully cast wax in gelatine molds. Briefly, the process consists of first preparing the mold by giving it a uniform and thin coating of oil and if of considerable size, the wax is usually applied with a brush in such a manner as to form a thin coating or film without either joints, entrapped air or oil. When this film hardens another coating is applied and this operation is repeated until the thickness is built-up as required. Considerable judgment and care must be exercised to prevent melting through the first film of wax in subsequent applications, and it is advisable to permit one coating of wax to harden before applying another. When the wax cannot be applied with a brush in intricate and small molds, the wax will have to be poured into the mold and slushed out immediately, leaving only a film. This can be repeated as often as necessary until the entire mold is coated. When pouring in the wax care must be exercised not to let it fall in a stream against the mold, otherwise the gelatine will be cut away and the mold ruined. Nor must the wax remain in the mold sufficiently long to liquefy and mix with the gelatine. The operation is a very delicate one, and the point to be kept in mind is to first form a wax film on the gelatine mold by chilling the wax before it can melt the gelatine and then to build-up the film to the required thickness of the casting. The temperature of the wax should be kept as low as possible. Pure beeswax is generally used and the shrinkage is controlled by the addition of Venice turpentine. Add 1 ounce per pound of wax and if the latter continues to shrink add more turpentine until the shrinkage is controlled.

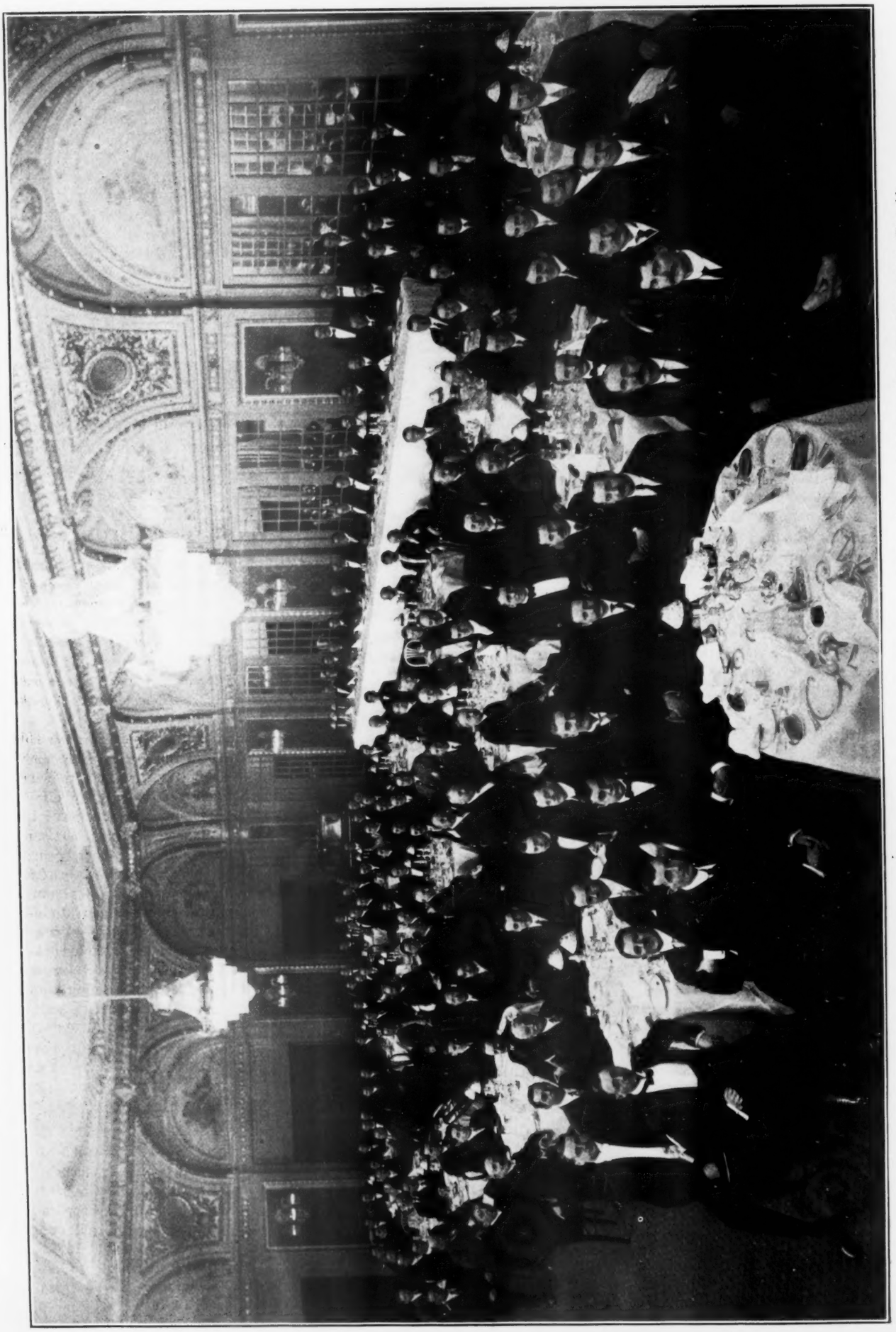
Manganese Bronze

We have experienced considerable trouble in casting manganese bronze. The formula we are using provides for copper, 58 pounds; zinc, 38 pounds; manganese-copper, 3 pounds; aluminum, 1 pound. The castings from this mixture are too hard. How can we make our castings more malleable and at the same time retain their strength?

You can obtain a more malleable metal by decreasing both zinc and aluminum, but the tensile strength will be correspondingly reduced. An alloy that can be recommended is as follows: Copper, 56 per cent; 30 per cent manganese-copper, 2 per cent; zinc, 40.75 per cent; phosphor tin, 0.5 per cent; iron (tin plate), 0 5 per cent, and aluminum, 0.25 per cent. Run into ingots and remelt for castings. When properly made this alloy should possess about 62,000 pounds tensile strength, 40 per cent elongation and 30,000 pounds elastic limit.

Briquetting Brass and Copper Borings

A process for briquetting metal turnings, borings, and other finely divided substances by the application of pressure, has been recently patented and is now in use in Germany. The briquettes are made by the application of high pressures which cause the finely divided particles of metal to assume a sufficiently plastic state to adhere together and form a solid mass. Briquetting plants have been installed in some German works, the scrap being



ANNUAL BANQUET OF THE CHICAGO FOUNDRY FOREMEN'S ASSOCIATION, HELD AT THE SHERMAN HOTEL, CHICAGO, SATURDAY, FEB. 11

received from outside concerns, which is briquetted at a fixed charge that ranges from $6 per ton for cast iron turnings to $16.50 for copper, bronze and brass chips. Why the latter should cost more to briquette than cast iron borings is difficult to understand, as it seems logical that less pressure is required for copper or brass, than for iron. However desirable the briquetting process may be for irons, there is no great need for this method for brass borings, as they are never melted in cupolas in contact with the fuel. Borings are generally melted in crucibles, which protect them from atmospheric and furnace gases and render their reduction a simple matter. It is a well known fact that metals can be liquefied by pressure, but the most economical way is by means of heat. Borings are generally melted in coke or oil-fired furnaces, and in this way, it might be said, that thousands of tons of bronze borings are yearly briquetted into the form of car journal bearings, which is another way of saying that they are run into castings direct. To insure success it is only necessary to keep an ever observant eye upon the progress of the melting operations and never to permit one charge of borings to wholly melt down before another is added. As the borings commence to melt at the bottom of the crucible, the top of the charge sinks down and the pot should be continually filled with additional borings, added with a scoop or by means of a funnel. When the borings cease to sink, they should be stirred with an iron bar and a small amount of soda ash, added from time to time, will be found to facilitate operations. In due time the crucible will be filled with molten metal, when two per cent of 15 per cent of phosphor-copper may be added to eliminate blow-holes. Repeated trials have shown that the loss can be easily held at 3 per cent.

Annual Banquet of Chicago Foundry Foremen

A FEW years ago a movement was started at various points in the United States to organize the foundry foremen into associations for purely educational and social purposes. Concrete evidence of the success which this movement has achieved is found in the annual banquet of the Chicago Foundry Foremen's Association, held at the Sherman hotel, Chicago, Saturday evening, Feb. 11. Over 200 members of the association and others connected with the foundry business attended, and the affair was in every way a distinct success.

Considerable life was injected into the proceedings by the Lewis Institute glee club, which sang a large number of popular songs and others composed for the occasion. The latter were of a highly humorous nature and referred feelingly to the troubles of the foundryman. J. G. Garrard, of the American Brake Shoe Co., president of the association, was toastmaster. The speakers included F. W. Thompson, of Buffalo, president of the Association of Foundry Foremen; Herman O. Lange, of Ferguson & Lange, Chicago; George Woodruff, president of the First National Bank, Joliet, Ill., and Hon. William E. Mason, of Chicago.

F. W. Thompson, president of the national organization of foundry foremen, made a brief address on the work of the association, stating that it now has 300 members. He told of the good work that is being done by the recently organized Buffalo Foundry Foremen's Association, and complimented the Chicago association on its splendid success.

Mr. Lange conveyed a bit of news to many of those in his audience in his statement that there is more iron melted daily in foundry cupolas in Chicago than in any other city in the world. He also pointed out Chicago's great advantages as a foundry center on account of its central location and comparative nearness to supplies of raw material. "The Chicago atmosphere," said Mr. Lange, "engenders a spirit of push and energy which results in the fiercest competition found in any city in this country, but this competition, in the foundry business at least, is being softened by the fellowship resulting from the work of such organizations as the Chicago Foremen's Association." Mr. Lange paid a high tribute to the foundry foremen and to their idealism. He said that in times of stress or emergency the foreman forgets entirely that he is working for wages and remembers only his responsibility to his employer and to the good name of the organization with which he is connected. "Idealism and lots of it is more necessary in the foundry than in almost any other line of work and is the one quality which gives to labor its dignity," concluded the speaker.

George Woodruff, who has traveled very extensively in the Orient and in South America, gave a very interesting address on "International Trade Opportunities," laying particular stress on the opportunities for American manufacturers in the iron and steel trade for business in South America and in China. He thinks that these two fields are the most promising in the world for American exporters. Mr. Woodruff pointed out the great potential wealth and wonderful natural resources of China and drew particular attention to the remarkable industrial awakening now under way in the Celestial Empire, where the opportunities for the sale of such machinery as is demanded by public utilities, electric light plants water works, gas companies, street railways, etc., are unusually good. He called attention to China's immense deposits of iron ore and coal, which form the basis for what may some day be the greatest iron industry in the history of the world. He stated, however, that the open door in China is more or less of a myth and that so far as trade is concerned, China is already partitioned among various European nations, English, German and French spheres of influence predominating. The trouble with American manufacturers has been that they have not sent men to the Orient who are willing to sell goods according to oriental methods, and to see the Chinese point of view.

The markets of South America, in the opinion of Mr. Woodruff, are much more attractive to Americans at the present time than those of China, because they are nearer and on account of the protection afforded Americans by the Monroe doctrine. The inhabitants of South America are also Caucasians. Of the various South American countries Peru, Brazil and Argentine are the most friendly to American enterprise. Some idea of the extent of South American markets is shown by the fact that Brazil, Argentine and Chili alone import foreign goods valued at more than $600,000,000 yearly, while all the importations of China are only $200,000,000 a year. The principal difficulties in the way of active trade between the United States and South America are the lack of American ships and American banks with foreign branches. Also there is a wide-spread ignorance of South American conditions among American manufacturers, who seem reluctant to take into account the Latin temperament. In concluding, Mr. Woodruff made a strong plea for the study of foreign trade opportunities by American iron and steel manufacturers.

CONVENTION OF INSTITUTE OF METALS

The annual meeting of this organization, held in London, was well attended -- Papers discussed and election of officers

By J. Horton

THE Institute of Metals, devoted to the study of non-ferrous metals, although the youngest of the scientific societies, is by no means the least vigorous. The annual meeting held in London, Jan. 17 and 18, furnished ample evidence that the Institute has quickly found its sphere of usefulness. One of the most interesting papers presented was prepared by Prof. H. C. H. Carpenter and C. A. Edwards, entitled "A New Critical Point in Copper-Zinc Alloys," and it was described by some of those in attendance as marking a new epoch in the study and treatment of copper. However, a keen competitor for pre-eminence at the meeting was the subject of "Copper Corrosion," especially as it relates to ship and mechanical equipment and boiler tubes.

The meeting was largely attended, and on Tuesday afternoon, Jan. 17, many of the visitors were permitted to inspect the new super-Dreadnought, Thunderer. A good deal of secrecy is maintained with regard to the equipment of these naval leviathans. The Thunderer, when finished, will have a displacement of 22,500 tons. On the evening of the same day, the annual dinner was held. J. A. F. Aspinall, responding to a toast, pointed out that copper practically dominated the program and was of the opinion that aluminum might be of great use in the construction of railway passenger cars. He said that for some time the Lancashire & Yorkshire Railway had been building the panels of these coaches of aluminum.

The business meeting of the Institute was held Wednesday morning and the report of the Council showed a membership of 551, an increase of 46 during the year. It was reported that a committee has been appointed to investigate the causes of and methods for the prevention of the corrosion of non-ferrous metals. A pathological museum of metals has been established at the offices of the institute, comprising specimens tending to show how non-ferrous metals and their alloys might fail in use. The formation of a library has also been commenced. Officers for the ensuing year were elected as follows: President, Sir Gerard Muntz; vice presidents, Professors Carpenter, Gowland and Huntingdon, Vice Admirals H. J. Oram, Sir Henry A. Wiggin, and W. H. Johnson; treasurer, Prof. T. Turner, and secretary, G. Shaw Scott.

In his presidential address, Sir Gerard A. Muntz described the work of the corrosion committee as of great moment, which was likely to have far-reaching effects. He pointed out that the difficulties met with in non-ferrous metals were legion, the causes of which were frequently exceedingly obscure and for this reason scientific investigations are essential in this field of endeavor.

Stripping of Silver-Plated Alloys.

An interesting paper on "The Stripping of Silver-Plated Nickel Alloys," prepared by Andrew McWilliams and W. R. Barclay, was presented, and is, in part, as follows:

A few years ago the authors had their attention called to a rather serious difficulty in connection with the behavior of high grade electro-plated spoons and forks under the very severe conditions of wear, to which they are subjected in hotels and restaurants. Spoons and forks manufactured presumably under the best commercial corditions, examined and passed by experienced observers before being sent out from the factory, and apparently only differing from ordinary plated ware in having an exceptionally heavy deposit of silver were, after actual usage of 18 months, or so, returned to the makers with the complaint that the silver coating was "peeling" or stripping along the edges and from parts of the surface of the articles. As the trouble was not confined to a few isolated pieces, or to any one manufacturer, it was felt that the matter warranted a thorough investigation, particularly as no specific fault could be traced in any of the processes through which these goods had passed.

Ordinary Causes of Blistering.

The ordinary causes of stripping, peeling, or blistering of electro-deposited silver were not discussed, as these troubles are due to inefficient cleaning, unsuitable plating liquid, careless treatment in the preparatory stages, etc., because articles defective in these respects rarely pass from the hands of reputable manufacturers. These faults are usually revealed during the subsequent finishing and burnishing processes, it being well known that if the slightest trace of grease or oxide remains on the surface of the basis metal, the electro deposited silver will blister under the pressure of the steel burnishing tools. From general experience, and the examination of many plated articles that had been a generation in wear, the opinion was formed that the adhesion bore some relation to the nature of the basis metal. For this reason the investigations were undertaken to determine not only the cause of the adhesion of electro-plated silver to a German silver base, but also to discover what difference, if any, exists between the various grades of these alloys in general use, and their degree of suitability as a basis for heavily electro-plated articles which are liable to receive rough usage. Table I gives the composition of the alloys accordingly made.

TABLE I.

Marks.	Nickel. Per cent.	Copper. Per cent.	Zinc. Per cent.
A	20	57	23
B	18	57	25
C	16	57	27
D	14	57	29
E	12	57	31
F	10	57	33
G	8	57	35
BZ	18	50	32
BC	18	64	18

Alloys Used.

The choice of these alloys is largely empirical, but they are fairly representative of the usual grades of copper-zinc-nickel alloys in commercial use. An effort was made to systematize the series by fixing the proportion of copper on the uniform basis of 57 per cent throughout, with the exception of the last two members, *BZ*, in which 7 per cent of the copper is replaced by zinc, and *BC*, in which 7 per cent of zinc is replaced by copper.

Each alloy has been made under the ordinary conditions of works practice, manganese being used as a deoxidizing agent. The metal was cast into ingots, about 18 pounds in weight. These were rolled into sheets of a thickness and width suitable for spoon and fork blanks, and cut up into strips each 8 inches long and varying from ½ to 1 inch in width.

In every respect these strips correspond to spoons or forks with the exception that they have not undergone the process of stamping. A few odd strips from some members of the series have been made into forks, and these have been submitted to tests in the same way as the blank strips.

The electro-silver-plating of these strips has been done under the best commercial conditions of manufacture, in an electro-plating shop through which large quantities of spoons and forks are daily passing. They have been prepared for the depositing vat with due care and with all the precautions which would be taken by any careful electro-plater to insure the best adhesion of the silver deposit, but they were not subjected to exceptional treatment.

The electro-plating solution used was the standard in use, consisting of double cyanide of silver and potas-

sium, and the weight of silver deposited on each strip was at least equal to that given to the highest qualities of spoons and forks and to those previously described. Table II gives the weight of deposit on the strips of each alloy, calculated per square inch of the surface.

TABLE II.

Marks.	Deposit per square inch in ounces troy.
A	0.0196
B	0.016
C	0.0215
D	0.021
E	0.017
F	0.024
G	0.024
BZ	0.0198

The slight variation in the weight of deposit is explained by the fact that it was considered advisable to give each strip a minimum deposit at least of the quality indicated, without in any way interrupting the course of deposition, such as by taking the specimens out of the vat for intermediate scratch-brushing. a practice often followed in the making of very heavy deposits in order to keep the coating as smooth as possible. The strips were consequently in the vat the greater part of the working day and naturally the rate of deposition varied as more or less work passed through the vat in the course of the day's operations.

Tests Applied.

The grinding principle in designing tests was to subject the samples to strains, such as the basis metal and its silver coating would be given, including a certain amount of movement relative to each other, which would produce a fracture of the coating. The fault in the cases of stripping, previously mentioned, appeared to be first, that the silver deposit has been cut through in the course of severe wear and the broken edges gradually curled or peeled. When the deposit is thick enough it can be readily pulled off the metal surface and in some cases it has been possible with care and patience to peel the silver away from a fork almost from one end to the other. With these points in view, several preliminary tests were made, and finally it was decided to adopt a simpler, cold bending test.

One part of the sample was gripped in a vise and the free part bent back and forth until broken. It is advisable that the bend should be about a right angle, that the deposit and the basis metal be given sufficient movement relative to each other. This test is an extremely severe one, and unless the metals are holding together almost as one, the silver must be parted from its base, inasmuch as on the outside of the bend the silver moves a greater distance than the basis metal.

In view of the results, it may be noted that the order of the increasing ductility of the metals was, as a rule, from the high percentage nickel alloys to the low ones, the latter bearing more bending before fracture than the former, the test being more severe for metals of the *G*, *F* and *E* types, than for *A* and *B*. In addition to the mechanical tests applied, representative sections were cut from each series for microscopical examination.

Results of the Tests.

In the case of alloys *G*, *E* and *F*, Table I, it was found exceedingly difficult to peel up the coating in any way. In some few cases just at the point of fracture, it was possible to raise up the silver coating very slightly at the top, but in endeavoring to raise it further the silver, though very tenacious and ductile, was broken instead of separating from its base. Test pieces of *A* and *B*, however, behaved in a very different manner, as in practically every instance the silver coating left the base at the point of fracture and in a large majority of instances it could be pulled away quite readily from a considerable part of the surface without breaking the silver. In the case of *C* and *D*, evidence of imperfect adhesion was not so pronounced as in *A* and *B*, but they are not considered as good as *E*, *F* and *G*.

A few samples of the higher nickel alloys were rather differently treated by being given a thin coating of copper from an alkaline copper solution, before being silver plated. These also showed evidence of imperfect adhesion, although not to the same extent as formerly, but are not to be compared in that respect to the lower percentage nickel alloys, *G*, *F* and *E*. These results were confirmed by subsequent experiments carried out with alloys obtained from other firms of German silver manufacturers. A considerable number of test pieces were burnished by experienced silver finishers before testing. This process is considered in the trade to be, in addition to a help in finishing, a reliable means of testing the adhesion of the silver and is accomplished by clamping the article firmly on a bench and then passing a small, dry steel burnishing tool over the entire surface, and particularly on the edges. Unless the silver is in closest contact at every point, it will not pass this test without blistering. Every one of the test pieces used in the investigation emerged successfully from this test.

Conclusions.

The investigations clearly indicate considerable differences in the adhesion of deposited silver to the various grades of German silver alloys, even when all are treated under the same conditions of practice, and the authors were of the opinion that this fact should have full consideration in choosing a basis metal for articles to receive the thickest silver deposits given, which will also be required to bear rough usage. They were not prepared to state that any one particular alloy is best for this purpose, but they considered they have fully proved that ordinarily commercial alloys of copper, zinc, and nickel containing more than 14 per cent of nickel are of doubtful utility in this respect. On the other hand, alloys of the types of *G*, *F* and *E*, used for carrying heavy silver coatings electro-deposited with due care, will endure exceptionally rough usage without giving any cause of complaint on the ground of the silver stripping.

An Unusual Tensile Test

By N. W. Shed

Question:—We have a contract for a number of large gray iron castings to be furnished the United States government and the specifications provide for a tensile strength of 28,000 pounds per square inch minimum and 39,000 pounds per square inch maximum. The test pieces are to be the same thickness as the casting, nearly 3 inches in diameter, and are to be machined down to 1.129 inches in diameter. The outside of the test piece is machined off, leaving a core a trifle more than 1 inch in diameter, which consists largely of soft, weak graphite. Do you believe that these requirements can be successfully fulfilled?

Answer:—The specifications for this iron are certainly severe. The grain of iron slowly cooled in large mass would be very open and with the graphite present you would naturally expect a low tensile strength. With an ordinary test bar these results could be easily obtained, but in this case you would have to have an iron of a special composition very different from the strong iron commonly made in a gray iron foundry. By using iron which has been carefully analyzed and by following up the analysis of the castings produced, it is possible to make such iron successfully. I have seen tests of iron of this kind which showed a tensile strength of 35,000 pounds per square inch when machined out of a heavy section.

German Crucibles

An analysis of a number of crucibles of German manufacture gave the following average results: Silica, 33 per cent; alumina, 12 to 13 per cent, and graphite, 48 to 50 per cent. The mixture therefore must have been about as follows: 1,000 pounds of Klingenberg clay, 1,550 pounds of Ceylon graphite and 375 pounds of crucible sand.

The "1911 Metal Statistics," published by the *American Metal Market and Daily Iron and Steel Report*, New York City, is the fourth edition of this work. It has been thoroughly revised and in many respects is superior to any of the previous issues. It contains statistics of production and prices of iron ore, pig iron, steel, finished products, scrap, copper, tin, lead, spelter, antimony, aluminum, silver, etc.

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Trade Outlook

Greater activity is reported in all branches of the foundry industry and the melt, particularly in gray iron and steel shops, has been materially increased during the last 30 days. New tonnage on which the foundrymen are now furnishing estimates is heavier than at any time since the early summer months of last year, and the outlook for continued improvement is bright. Since the first of the year the jobbing pattern shops have gradually increased their operating forces and this is usually considered the forerunner of new work that will ultimately be offered to the foundries. No important improvement and extension projects have yet been announced by the railroads, although car orders are more plentiful, and this has been the source of a large tonnage of malleable and steel castings recently placed with the foundries. Replacement work is figuring largely in the steel casting tonnage as a number of railroads have decided to discard malleable couplers entirely for steel. The malleable foundries have recently increased their melt to meet the requirements of the implement manufacturers, but the output of malleable castings is still far below normal. Specialty shops, notably those manufacturing gray iron cylinders and converter and crucible steel castings for the automobile trade are busily engaged and the demand for aluminum and brass castings for motor cars continues heavy. The inroads made in pig iron stocks at merchant furnaces, especially in Ohio and western Pennsylvania, reflects not only the increased activity of all manufacturing lines, but also indicates that iron consumption has again overtaken production. There has been practically no change in pig iron values, although the market in all of the leading centers is on a firmer basis. No. 2 foundry iron is quoted as follows: Pittsburg, $14.65; northern, Chicago, $15.50; southern, Cincinnati, $14.25; Philadelphia, $15.25; Birmingham, $11, and Cleveland, $14. At Pittsburg, basic iron is held at $14.65, but in the east the furnace operators are asking $15. Sharp advances have been recorded in all grades of cast scrap and dealers are inclined to hold their large accumulations for higher prices than are now prevailing. Speculation in tin continues the feature of the non-ferrous metal market. Wide fluctuations in prices were recorded in this metal during the month and the outlook is not favorable to the establishment of this market on a firm basis in the immediate future at least. There has been no material fluctuation in the price of either lake or electrolytic copper, although makers of special brands of antimony are reported to be confidentially advising the trade of an early advance in prices. Lead and spelter quotations remain practically unchanged.

Tradition in the Foundry Industry

Tradition may retard, but cannot stay progress. This is nowhere better exemplified than in the foundry industry. Archaic methods, handed down from generation to generation, unfortunately, prime importance that, until comparatively recent years, retarded the quently frowned upon by the standpatters and for no other reason than that it has never been the custom to do the work in any other way. And tradition has retarded progress in the art of founding. It was the factor of prime importance that, until comparatively recent years, retarded the widespread use of the molding machine. The introduction of chemical analyses of pig iron and iron mixtures in the foundry met a formidable foe in tradition, and in fact every labor-saving appliance for the casting plant, before its adoption, was compelled to overcome the traditions of existing practice. The manufacturers of piano plates have always opposed the application of molding machines to their work, and for no other reason than that it has always been the custom to mold these castings by hand. To demonstrate the economy and efficiency of machine-molding over hand-molding in making these plates was left to a tyro in the art of founding. Without previous experience in foundry work, an investigation of the standard practice did not satisfy him that it could not be improved. Proceeding, blindly at first, but guided later by an experienced molding machine manufacturer, he has effected not only economies in the cost of production, but has also improved the product. The molding expense has been reduced two-thirds, and with one molding machine five unskilled men now equal the output of nine molders and nine helpers. In this instance, fortunately, the manufacturer was not versed in the traditions of foundry work. The details of this accomplishment, which will revolutionize piano plate practice, appear elsewhere in this issue.

Personal

H. R. Linton, formerly general manager of the Centre Foundry & Machine Co., Wheeling, W. Va., has been appointed general manager of the Kewanee Foundry & Mfg. Co., Kewanee, Ill.

W. H. Fitzpatrick Jr., who has been associated with the Detroit Foundry Supply Co., Detroit, for several years, has severed his connection with this concern and is now affiliated with the S. Obermayer Co., Cincinnati.

H. D. Cole, who has been associated with the Jonathan Bartley Crucible Co., Trenton, N. J., since its organization, is now representing this concern in the eastern states and will shortly be making his headquarters in New England.

E. F. Lake, Avenue B and Forty-seventh street, Bayonne, N. J., has resigned as steel editor of the *American Machinist* to engage in consulting metallurgy and will furnish expert advice on the melting, alloying, casting, welding, heat treating, and testing of metals.

Book Reviews

The Scientific American Cyclopedia of Formulas, edited by Albert A. Hopkins, query editor of the *Scientific American;* 6½ x 8¼ inches, 1,077 pages and 200 illustrations; published by Munn & Co., and furnished by THE FOUNDRY, bound in cloth, for $5, postpaid.

This work is partly based on the twenty-eighth edition of the "Scientific American Cyclopedia of Receipts, Notes and Queries," but is practically a new compilation and contains 15,000 formulas and processes, carefully selected from a collection of nearly 150,000. The formulas are classified and arranged into chapters containing related subjects, while a complete index renders it easy to find any formula desired. The chapter on alloys and amalgams occupies 69 pages and contains 1,400 formulas. The subject is elaborately classified, general information regarding the properties of alloys being first given, which is followed by general tables of alloys. No less than 50 formulas for amalgams are included, as well as a large number of bismuth and cadmium alloys, and a large collection of fusible alloys melting at different temperatures. The subject of copper alloys is extensively treated, several hundred formulas being given. Other formulas include German silver, bell metal, bronzes of every description, phosphor bronzes, silicon bronzes, speculum metals, bearing metals, brasses of all kinds, together with elaborate directions for making these mixtures.

The chapter on electro-metallurgy and hot and cold coating of metals, occupies 29 pages and contains 300 formulas. It deals with the preliminary treatment of metals to be plated, including cleansing, pickling, scratch-brushes, etc. The chapter on the heat treatment of metals, annealing, brazing, hardening, tempering and welding, consists of 10 pages and contains 130 formulas. Another chapter on lacquers, stains, bronzing, etc., contains 1 000 formulas. The work is divided into 27 chapters and the appendix is divided into three parts as follows: Miscellaneous formulas, which did not lend themselves to classification, chemical manipulations and tables of weights and measures.

A Textbook of Elementary Foundry Practice.—By William Allyn Richards; 6 x 8½ inches, 121 pages; illustrated; supplied by THE FOUNDRY for $1.25.

The aim of the author of this work has been to provide a textbook on foundry practice that could be used to teach the first principles of the molding and casting of metals, and which can be used by high school pupils and others desirous of obtaining an elementary knowledge of the processes involved in foundry practice. With this idea in view, molding sands, facings and other similar materials are first discussed and their properties and uses explained. The tools used, such as flasks, sieves, shovels, rammers, clamps, etc., are next described and their uses explained.

The principles of molding, venting and gating follow, with detailed instructions for making molds, matches and cores, also open sand and dry sand molds. A chapter on cupola practice is included and brass molding is discussed in the last chapter, in which the various tools and furnaces are described and methods of molding outlined. A glossary of technical terms used in the foundry follows, and tables giving the melting points, strength and specific gravity of metals, formulas of alloys, cupola hints, miscellaneous recipes and other useful facts and data are also included.

Tate, Jones & Co., Pittsburg, have issued a circular describing a portable, fuel oil burner of the compressed air type, which can be used for heating ladles, drying molds, lighting cupolas, etc.

British Foundrymen's Convention

At a recent meeting of the executive committee of the British Foundrymen's Association at Birmingham, England, it was decided to hold the next convention at Glasgow during Bank Holiday week in August. A large number of papers on practical and scientific subjects are already being prepared, and a plant visitation program is being outlined which will afford the visitors opportunities of inspecting some of the large foundries and ship building yards in Scotland. The membership of the association is rapidly increasing and now totals approximately 600. A suggestion has been made, which will be considered at the annual meeting, that provides for the presentation of medals and diplomas for the best papers read, not only before the local associations, but before the national body as well.

One of the most recently organized local associations is the Lancashire branch, which has its headquarters at Manchester, Eng. At the recent annual dinner there was an attendance of 75 and toasts were responded to as follows: "The British Foundrymen's Association," "The Lancashire Branch," "The Visitors" and "The Press." The toasts to "The Press," proposed by F. Penlington, who spoke warmly of the service rendered by the technical publications and who eulogized THE FOUNDRY in particular, was responded to by J. Horton, of Birmingham, European representative of THE FOUNDRY.

Concrete Patterns

"The Molder of Today and the Patternmaker of the Future" was the subject of an address delivered by Jos. Leon Gobeille before the Buffalo Foundry Foremen's Association at Ellicott Hall, Buffalo, Tuesday evening, Jan. 31. Mr. Gobeille directed attention to the experiments which he has been conducting with concrete as pattern material and there is every indication that this problem will soon be solved successfully. Patterns have already been made that have given good service in foundries in which they have been used.

The Hawley Down Draft Furnace Co., Chicago, is sending a four-page bulletin to the trade, which briefly illustrates and describes several of its furnaces adapted for melting brass, aluminum, steel, etc.

FOUNDRY and PATTERN SHOP EQUIPMENT

Universal saw table---Large grinding wheels---Twisted steel gaggers---Canvas bellows---Two barrel tumbling mill---High pressure, closed hopper sand blast

A UNIVERSAL saw table, particularly adapted to pattern work, is shown in Fig. 1. The column or main frame is a heavily ribbed casting with a large, arched opening on the side to permit of the inspection of the inner mechanism. The table, overall, is 42 inches long, 40 inches wide and is divided into three sections, including the main table which is at the right of the saw, the sliding table, and the shelf or section at the left of the sliding table. This division of the table into three parts permits of the rapid operation of the sliding table which is 12 inches wide and 40 inches long. It is mounted on dust-proof roller bearings and travels in carefully scraped and fitted trackways. These ways are located in an intermediate track, which is adapted to be moved out or in from the saw, thus providing ample room for dado heads up to 2 inches wide. The outer portion of this track is extended to the left and upward, level with the sliding table, thus providing a shelf for supporting long work. The entire table can be tilted through the various angles up to 45 degrees, by a hand wheel which operates a cut steel pinion running in a steel rack.

The ripping gage may be set to rip stock up to 21 inches and may be used either on a stationary or sliding table. When ripping is to be done with the table tilted, the ripping gage is placed on the left hand or lower side. This firmly supports the stock and is advantageous when working heavy material, as its own weight holds it against the gage. This gage tilts to an angle of 45 degrees from the table. For cutting out hollows such as core boxes, the gage may be set diagonally to the table, using one of the taper pins as a pivot and removing the other taper pin and clamping the gage in the desired position by a thumb screw. The ripping gage is also provided with a small, square block which may be attached to its face and used as a gage for cutting off short pieces. The use of the block prevents the pieces from wedging between the saw and the gage after they are cut.

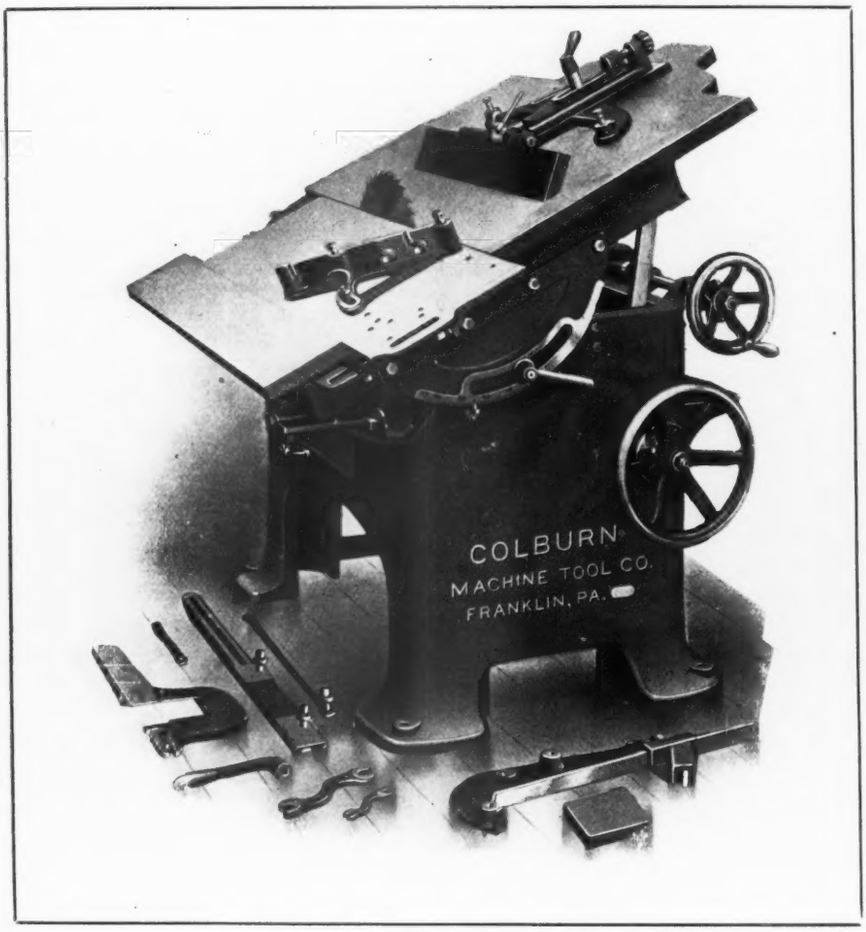


FIG. 1—THE COLBURN UNIVERSAL SAW TABLE

The cutting-off gage is drilled into the sliding table in two positions. The front position permits the widest kind of work to be cut off. The gage can be quickly set for cutting triangles, miters, hexagons and octagons, pinholes being drilled for all three angles. The taper pins are ground on dead centers and all holes in both the stationary and sliding table are carefully reamed. An auxiliary cutting-off gage is furnished with the machine which is provided with end stops, and permits of cutting-off work up to 60 inches long. The machine is equipped with an outer saw arbor which eliminates vibration. The saw arbors are 1 3/16 inches in diameter and operate in self-oiling bearings. The flanged saw arbor pulleys are 4 inches in diameter and are made for a 5-inch belt. They should be operated at 2,800 revolutions per minute. Provision is also made for taking up the end motion of the arbors. The saw equipment consists of one 14-inch rip saw and one 14-inch cross-cut saw which will cut stock 4 inches thick. Saws as large as 18 inches may be used which will cut through 6-inch stock. When a saw larger than 14 inches is used the one on the opposite arbor must be left off, or a smaller one substituted. A 16-inch saw may be used on one arbor and a 12-inch saw on the other. One of the saw arbors is made extra long so that dado heads up to 2 inches wide may be used.

The tight and loose pulleys are 10 inches in diameter and 6-inch face. The loose pulley is slightly smaller than the tight pulley, with a beveled flange on the edge between them so that the belt will easily mount or descend from one to the other. This permits the belt to run slack on the loose pulley and overcomes the strain on the belt when the machine is not

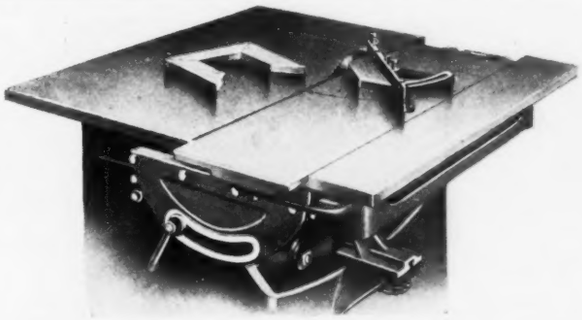


FIG. 2—UNIVERSAL SAW TABLE ARRANGED FOR SAWING SECTIONS FOR MITERS

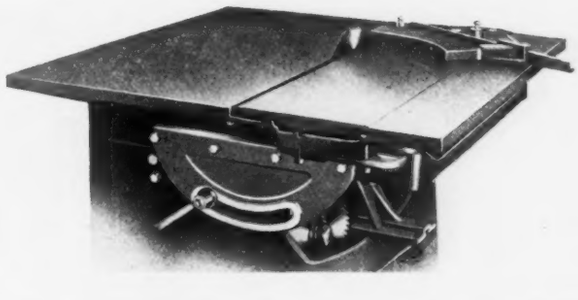


FIG. 3—UNIVERSAL SAW TABLE WITH SEGMENT CUTTER ADJUSTMENT

in operation. The driving pulley is 15 inches in diameter and has a 5-inch face. The floor space occupied by the machine is 42 x 42 inches and the net weight with countershaft is 1,700 pounds. When equipped for motor drive, an extension plate is attached to the main frame and the size of the motor required is 5 horsepower.

In Fig. 2 the saw table is arranged for cutting sections for miters. Holes for taper pins are drilled in the sliding table for quickly setting the cutting-off gage for this and other angles. Each hole is plainly marked. Fig. 3 shows a saw table with the segment cutter adjustment which is especially intended for pattern work. It is customary to glue segments for pulley, gear wheel and similar patterns, which are generally made so that six segments complete the circle. The segments are first sawed out rough on a jig or band saw and are left long on either end. The segment cutter is attached to the sliding table and consists of a plate having a projecting lug which is close to the saw. The sliding head may be clamped in any position along the front edge of the plate. A plunger rod is fitted into a slot in the sliding head and is forced out about ¼ inch by a spiral spring. The first operation is to cut one end of the segment which is pressed against the plunger which is forced in until the wood comes in contact with the head. The other end rests against the lug and extends out slightly beyond the saw. The end of the segment is then cut off. The plunger being then released, extends out and the finished end of the segment is set against it. The other end then lies against the lug and beyond the saw, and is cut off in this position. This always cuts the ends 60 degrees to each other. The scope of the attachment is greatly increased by the segmental slot which permits the plate to be swung to a greater angle than 60 degrees and clamped, thus making it possible to saw almost any number of segments to make up a circle.

Fig. 4 shows a saw table arranged for sawing bevels in such work as staves for columns and similar patterns. Fig. 5 shows the saw table arranged for sawing out round core boxes by successive cuts with the periphery of the saw. For this work the splitting fence is set diagonally to the saw, one of the taper pins acting as a pivot and the thumb screw clamping it firmly in position. This universal saw table is built by the Colburn Machine Tool Co., Franklin, Pa.

Wadsworth Core Shop Equipment

George H. Wadsworth, inventor of the Wadsworth line of core room equipment, has made arrangements with the Falls Clutch & Machinery Co., Cuyahoga Falls, O., to purchase its entire core room equipment machinery, together with the stock on hand, tools and patterns, and after March 1 will continue this business under the firm name of the Wadsworth Core Machine & Equipment Co., with headquarters at Akron, O. Mr. Wadsworth has resigned as superintendent of the Falls Clutch & Machinery Co., Cuyahoga Falls, O., successor to the Falls Rivet & Machine Co., after an affiliation extending over a period of 15 years, and this will give him an opportunity of devoting his entire time to the manufacture of core room equipment, in which line of work he has been engaged for the past 10 years.

When placing contracts for 1911 rail requirements amounting to 41,500 tons, the New York Central railroad specified the use of 1 per cent of 10 per cent titarium alloy in all of the steel from which these rails are to be rolled. More than 400 tons of 10 per cent alloy will

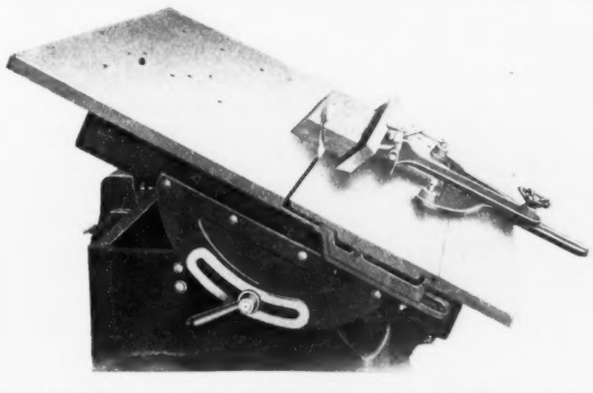


FIG. 4—METHOD OF SAWING BEVELS ON THE UNIVERSAL SAW TABLE

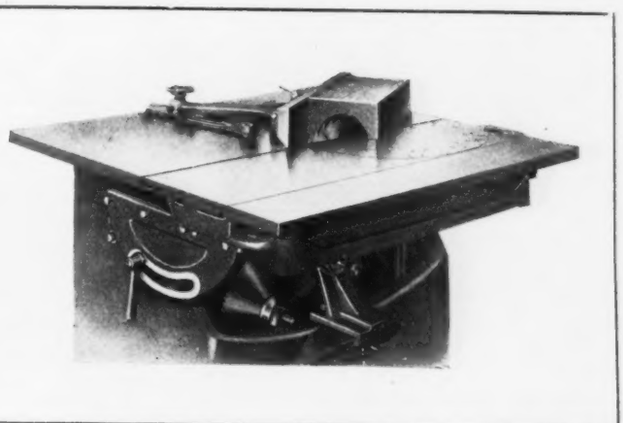
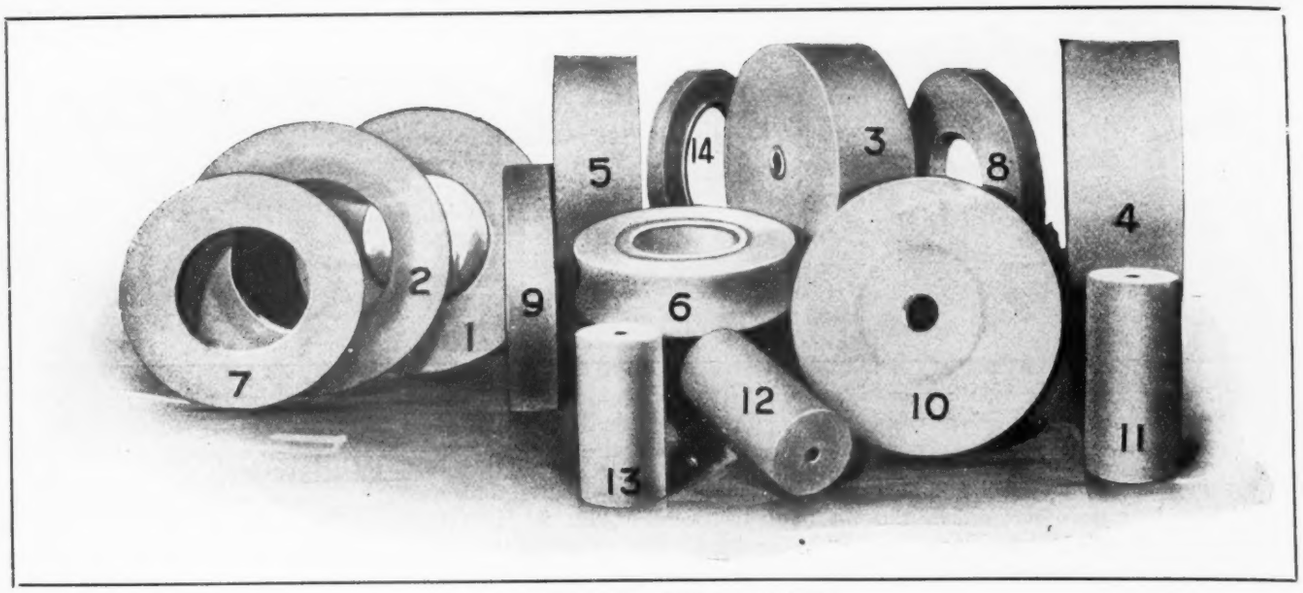


FIG. 5—SAWING OUT ROUND CORE BOXES ON THE UNIVERSAL SAW TABLE

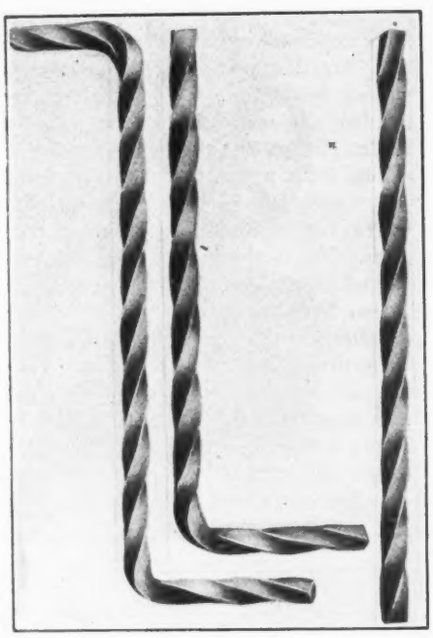


LARGE CARBORUNDUM GRINDING WHEELS

be required for this purpose. The strength of the titanium content may be increased to 15 per cent, thus necessitating the use of a proportionately smaller quantity of the alloy, but the requisition in any event constitutes the largest single order yet placed for alloy steel rails. The order for the titanium alloy was placed with the Titanium Alloy Mfg. Co., Pittsburg.

Large Grinding Wheels

What is said to be the largest vitrified grinding wheel ever made is shown in the accompanying group of large abrasive wheels manufactured by the Carborundum Co., Niagara Falls, N. Y. This is wheel No. 2, which is made of Aloxite, a steel grinding abrasive recently placed on the market by the Carborundum Co. This wheel is 48 inches in diameter and is to be used for tool grinding. The net weight of the group of wheels is 8,350 pounds and Nos. 3 and 4 are two large Carborundum drum wheels, 39¼ inches in diameter and 18⅛ inches thick, which are to be used for hulling grain. No. 6 is a vitrified Aloxite wheel, 36 inches in diameter and 9 inches thick, which is to be used for pointing cast steel wire; No. 5 is a drum wheel made of silicate Aloxite, 40 inches in diameter and 14 inches thick, which is to be used in grinding mower sections; No. 9 is a silicate Aloxite wheel, 40 inches in diameter and 4 inches thick, to be used in grinding thin steel bands; No. 14 is another silicate Aloxite wheel, 36 inches in diameter and 4 inches thick, to be used for tool grinding; No. 1 is 48 inches in diameter and 3 inches thick and will be used for grinding cutlery steel; No. 8 is a vitrified Aloxite wheel, 36 inches in diameter and 4 inches thick, which will be used for grinding angle iron; No. 7 is a silicate Aloxite wheel, 38 inches in diameter and 3 inches thick, which will be used for grinding glass; No. 10 is a Carborundum wheel, 40 inches in diameter and 8 inches thick, which will be used for grinding structural steel. Three vitrified Carborundum cylinders, 12 inches in diameter and 26 inches long, to be used for grinding vitrified tile, are also shown.



TWISTED STEEL GAGGERS

Twisted Steel Gaggers

Realizing that a rough surface will hold better than a smooth one when embedded in sand, the Franklin Core Rod & Gagger Co., Franklin, Pa., has devised the new type of twisted steel gagger, shown in the accompanying illustration. This gagger possesses a uniformly rough surface that gives it a good grip on the sand, and at the same time permits it to lie closely to the bars of the flask.

Ordinary gaggers with smooth shanks possess such slight sand-holding power in a shallow cope, that unless they are hooked over the bars or are largely supplemented with soldiers, their weight will increase the danger of a drop out, instead of reducing it. To test the relative degrees of firmness with which twisted steel gaggers and round bar gaggers are held by packed sand, a number of experiments were made by ramming up a cope in which a number of twisted steel gaggers and round bar gaggers were embedded adjacent to the bars and the cope was then supported horizontally by horses at a convenient height above the floor. The heel of each gagger was looped and the loop protruded from the sand of the cope to provide means by which the gagger could be weighted until pulled from the sand and the weight necessary to accomplish this, would indicate the relative efficiency of the two kinds of gaggers.

When the cope was lightly rammed and no clay wash was used on either twisted or round gaggers, it required 13 pounds to pull out a ¾ inch twisted gagger, and 18 pounds to pull out a ½ inch twisted gagger, while the ¾ inch round gagger was pulled out of the sand by a 2-pound weight, and the ½ inch round gagger only held 3 pounds. With a mold rammed hard, as in steel practice, the shanks of

both kinds of gaggers being embedded 6 inches in the sand, it required 48 pounds to pull out the ¾ inch twisted steel gagger, and 81 pounds for the ½ inch twisted steel gagger, while the ¾ inch round gagger was pulled out with a 7-pound weight and the ½ inch round gagger with a 9-pound weight. The shanks of the round gaggers were then clay-washed to increase their sand-holding quality, the twisted gaggers being uncoated as during the previous tests. The ¾ inch, round gagger sustained a weight of 13 pounds and the ½ inch, round gagger, 18 pounds. These results showed that the sand-holding property of the twisted steel gagger is approximately four times that of the round gagger, even when coated with clay wash.

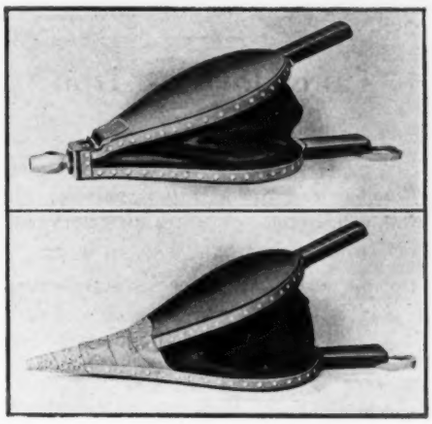


FIG. 1—CANVAS BELLOWS EQUIPPED WITH A HINGE AND AN ALOMINUM SPOUT
FIG. 2—CANVAS BELLOWS, PLAIN TYPE

Canvas Bellows

In Figs. 1 and 2 are shown two styles of molder's bellows, manufactured by the Osborn Mfg. Co., Cleveland, in the construction of which chemically treated canvas is used instead of the usual calf skin, sheep skin or horse hide. It is claimed that the canvas will give better service than the leather without adding to the cost of the device. Chemically treating this canvas makes it extremely pliable so that it will neither split, tear nor crack and in addition it is rendered air-tight and moisture proof. In Fig. 1 is shown the Cyclone bellows provided with a steel hinge and an aluminum spout in which are large side openings which insure a maximum amount of air. The plain type bellows is shown in Fig. 2. These canvas bellows are furnished in six regular sizes, varying in width from 8 to 14 inches.

Slow Melting

By W. J. Keep

Question:—Our cupola is lined to 37 inches and the distance from the sand bottom to the lower side of the tuyeres is 16 inches. We charge 910 pounds of coke on the bed, which is followed with a charge of 2,400 pounds of iron and the succeeding charges consist of 160 pounds of coke and 1,600 pounds of iron. We melt 4½ tons of iron per hour and our melting ratio is 7.33 pounds of iron to 1 pound of coke. The coke consumption seems high and the melting is apparently slow. However, our iron is hot. We find that the charges occasionally hang at a point about 42 inches above the bed and have tried to slag-off through a slag hole 6 inches below the lower tuyeres, but this did not prove successful. The blast pressure averages from 11 to 13 ounces.

Answer:—As the charges hang just above the melting zone it is advisable to close the upper tuyeres and make your coke bed of such a depth that it will reach to a point 15 inches above the lower tuyeres. You will require less coke on the bed, not more than 700 pounds. After you have run in this way for several days cut down the coke charges 10 pounds each and this can be still further reduced if the iron comes hot, or you might increase your iron charges 50 to 100 pounds for each charge. Your scrap should be broken as small as the pig iron and should be charged uniformly. Add about 20 pounds of limestone to the bed and to each coke charge after the fifth. Do not tap the slag until the heat is half off. Your melting ratio will then be approximately 8 to 1 and your cupola should melt about 6 tons per hour.

Steel Scrap in the Malleable Shop

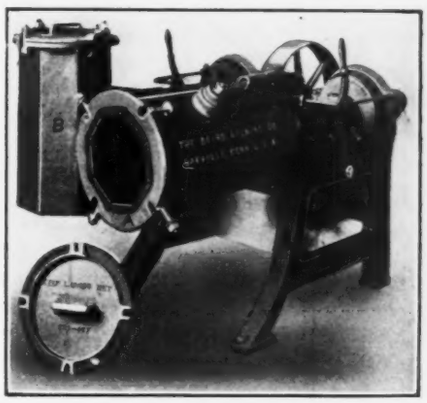
By Richard Moldenke

Question:—We have a large amount of mixed malleable and steel scrap in our yard and we would like to know whether we can use this scrap, either for annealing boxes by melting it in the cupola, or whether it could be used, when properly mixed, for making malleable iron?

Answer:—Practically every malleable shop operating a finishing department is confronted with the problem of disposing of its accumulation of annealed malleable scrap and steel. A reasonable amount of this scrap may be used in the regular mixtures if the air furnace and open-hearth methods of melting are employed. When melting malleable in the cupola, however, more care must be exercised, as the stock is so easily damaged that steel additions, accompanied by considerable oxidation in melting, may mean trouble in the anneal. It is not wise to use more than 5 per cent of steel scrap in the mixture, but malleable scrap can be used in larger proportions. As both steel and malleable scrap can be sold at fair prices, we would suggest that you sell your accumulation and hereafter use both the steel and annealed malleable scrap as fast as you make it. The chances of ruining your heats are great when using material that has become rusted by long exposure to the weather. Care should be exercised to have sufficient silicon in the mixture to carry this scrap and this element should be increased at least 10 per cent over the calculated amount ordinarily found necessary. This scrap should be mixed uniformly with the pig iron and sprues when it is charged.

Two-Barrel Tumbling Mill

In the accompanying illustration is shown a double, horizontal, tilting tumbling mill for burnishing and buffing castings, stampings, screws, etc., with steel balls, built by the Baird Machine Co., Oakville, Conn. The two barrels of the mill are operated in the horizontal position, *A*, but when being filled the barrels are in the vertical position, *B*. A pulley of ample size drives both barrels by means of bevel gears, and the arrangement is such that either barrel may be operated independent of the other. This permits the operator to run one barrel while emptying or filling the other. Owing to the use of friction clutches the driving pulley is belted direct to a line shaft, the use of a countershaft being unnecessary. The barrels are lined with maple, which can readily



TWO-BARREL TUMBLING MILL

be renewed. The barrels have an inside diameter of 10½ inches and are 24 inches long. It has been found from experience that barrels of small diameter lessen the danger of bending or otherwise injuring small or delicate pieces. The tilting of the barrels is easily accomplished, as they are supported on trunnions near their centers by heavy yokes secured to the driving shafts.

Closed Hopper Sand Blast

A high pressure, closed hopper sand blast, built by the Curtis & Co. Mfg. Co., St. Louis, adapted for cleaning castings, structural steelwork, etc., is illustrated herewith. This machine embodies a number of novel features of construction, including the throttle control for starting and cutting-off the flow of sand and air, sand feeding valve and mixing chamber and the screen on top of the sand hopper. As all of the sand is passed through the screen before entering the sand hopper, over-size gravel cannot enter the nozzle, thereby stopping the flow of sand. The flow of sand into the hopper is controlled by a valve operated by the weighted lever shown at the side of the screen. This sand blast is also equipped with a feed valve which regulates the flow of sand into the mixing chamber. The valve is simple in construction and is the only part of the machine requiring adjustment. To remove the moisture from the air, this device is equipped with a baffle plate separator, which practically eliminates the difficulties arising from wet sand in sand blast operations. A clear-out valve, however, is provided for removing sand that becomes clogged in the feed valve. The hopper has a capacity of 1,500 pounds of sand.

The Curtis company also manufactures an open hopper, high pressure sand blast, designed for work requiring only medium abrasive action. For such work the open hopper type is recommended, as the closed hopper machine has been built for work requiring great abrasive action. A Curtis open hopper sand blast was recently employed for cleaning the McKinley bridge over the Mississippi river, at St. Louis, before repainting.

The Pawling & Harnischfeger Co., Milwaukee, builder of cranes, hoists, etc., announces the opening of a branch office at 533 Baronne street, New Orleans, under the management of T. W. Waddell.

Sand Burnt Castings

By W. J. Keep

Question:—Our pig iron averages from 2.65 to 2.80 per cent silicon and we use ordinary, agricultural scrap in our mixtures. The metal is cast slightly duller than stove plate. We use a large number of cores in our work and these, after being removed from the castings, find their way into the sand heaps. Our heaps consist largely of new sand, which invariably burns on the castings, so that more than the ordinary amount of tumbling is required to clean them.

Answer:—After shaking-out, the castings should be carefully removed to the gangway to prevent the core sand from getting into the heaps. If you

CURTIS CLOSED HOPPER, HIGH PRESSURE SAND BLAST

desire to save the burnt sand from the surface of the casting it should be scraped off immediately after shaking out. If you are making light machinery castings you should add a small amount of sea coal facing to the sand. If your castings are light, such as stove plate, you can use a fine molding sand, dusting graphite and charcoal onto the molds. The pattern should then be printed-back. If it is not your desire to print-back the pattern graphite should be applied to the mold with a brush. The bright, silvery surface of stove plate is imparted to the castings not only by the facing, but also by the high silicon content of the iron. The higher the silicon the cleaner the castings. It might be advisable to use iron containing 3 per cent silicon, although 2.75 per cent silicon will prove satisfactory. Probably your pig iron is low in silicon and your agricultural scrap will not contain more than 2.25 per cent of this element. When using this scrap it is probable that your castings do not analyze over 2.50 per cent silicon.

Cores for Cast Iron Pipe

W. D. Forbes, in the *Metal Worker, Plumber and Steam Fitter,* presents the following table of core diameters for cast iron pipes from ⅛ to 10 inches:

Diameter of pipe, inches.	Core diameter, inches.
⅛	21/64
¼	29/64
⅜	45/64
½	57/64
1	1 ¼
1¼	1 ⅝
1½	1 ⅞
2	2 7/16
2½	2 15/16
3	3 ¼
3½	3 ¾
4½	4 ¾
5	5 5/16
6	6 5/16
7	7 3/16
10	10 13/16

The various sizes of these cores will insure the exact amount of metal required for cutting full threads in pipes.

Aluminum in Cast Iron

By N. W. Shed

Question:—I would like to know how much aluminum should be used in about 40 tons iron, which is used for the production of castings, varying from 3/16 to 7/16 inch in thickness. What would be the effect of adding too much aluminum to the metal?

Answer:—The quantity of aluminum added to cast iron is usually 1/10 of 1 per cent, and for 80,000 pounds of metal this would mean an addition of 80 pounds of aluminum. Probably the same effect could be produced with a smaller amount of aluminum. This material is used for the purpose of deoxidizing the metal only. If the castings are high in silicon, practically nothing is gained by adding aluminum except a slight stirring up of the metal before pouring. The action of aluminum is similar to that of silicon, and even in small quantities has a tendency to weaken the iron. If too much aluminum is added, a certain amount of oxide of aluminum will be formed, which produces a hard, gritty surface to the metal and forms a gray scum. It is difficult to mix the aluminum with the iron and it is not an easy matter to skim the ladle after adding aluminum, as the aluminum breaks up the cinder that

forms on the surface of the melted metal. Many firms have used small quantities of aluminum and have obtained good results, but equally good results have been obtained from the use of ferro-manganese, which is also much cheaper. Aluminum is of great value in the steel industry, as it helps to produce solid ingots and castings, but when used in cast iron, especially when the metal is high in silicon, its value is questionable.

Trade Notes

E. J. Woodison, formerly president of the Detroit Foundry Supply Co., has organized the E. J. Woodison Co., with headquarters at Detroit, where will be carried a complete line of foundry supplies, including fire brick, facings, etc.

The W. W. Sly Mfg. Co., Cleveland, reports heavy sales of rosin grinders. The device made by this concern for pulverizing rosin for use in core mixtures not only crushes the rosin, but also passes it through bolting cloth, from which it is deposited in a bin below the mill, from which it can be removed as required.

The Yale & Towne Mfg. Co., New York City, has been awarded the contract for installing a complete monorail overhead tramway system in the new plant that is being erected by the J. H. Ladew Co., Newark, N. J. The equipment comprises about three-fourths of a mile of I-beams, three traveling cranes, transfer devices, automatic fire door attachments, etc.

E. H. Schwartz has severed his connection with the Kroeschell Bros. Co., Chicago, having sold his furnace patents to this concern. Mr. Schwartz is now general manager of the firm of E. H. Schwartz & Son, of which E. H. Schwartz Jr., is the president. This company will engage in the manufacture of gyratory circulation gas fuel boilers and steel, iron, malleable and brass melting furnaces.

The Rockwell Furnace Co., 26 Cortlandt street, New York City, has issued a four-page bulletin, which illustrates and describes a combination tool room furnace for accurately heat treating small tools, etc., and for annealing, hardening, tempering and forging. Illustrations are also included of a number of large annealing, tempering and case-hardening installations made by this company in various plants throughout the country.

Frederic B. Stevens, Detroit, manufacturer of foundry supplies and equipment, is sending to the foundry trade a 12-page booklet, entitled "The Awakening of Old Cyril Simons." This story of Uncle Cyril and his awakening, is pointed to as a moral for the guidance of foundrymen who, the booklet says, have had similar awakenings when using "King Kore Kompound." The use of this core compound is described at length and a number of valuable mixtures are included for cores for light and heavy gray iron, aluminum and malleable castings.

The Sullivan Machinery Co., Chicago, announces the appointment of Howard T. Walsh as manager of its London office, and J. C. West, sales engineer during the past 10 years, succeeds Mr. Walsh as Pacific coast manager. The San Francisco office of this company is located in the Sheldon building. A branch office has been established in the Hutton building, Spokane, Wash. This office will be in charge of Austin Y. Hoy. Stocks of machinery will be carried as at present in Seattle, Wash., and Nelson, B. C., and in addition a stock of air compressors, rock and hammer drills will be carried by the Wallace Supply Co., Wallace, Idaho.

Trade Publications

ROCK DRILL MOUNTINGS.—The Ingersoll-Rand Co., New York City, in a 44-page bulletin, illustrates and describes its standard line of drill mountings, air and steam hose, drill steels and other accessories of complete rock drilling equipment.

STEEL SASH.—The Detroit Steel Products Co., Detroit, in a 36-page catalog, illustrates and describes its line of solid steel sash made in standard sizes. Details of construction of various types of sash are included and a number of illustrations of various industrial plants in the construction of which this sash has been used, are included.

PNEUMATIC APPLIANCES.—An extensive line of pneumatic appliances for foundry use, is illustrated and described in a 64-page catalog issued by the Curtis & Co. Mfg. Co., St. Louis. This equipment includes air compressors, air hoists, pneumatic elevators, pneumatic bridge cranes, I-beam trolleys, open and closed hopper, high pressure sand blasts and compressed air accessories.

NORTHERN CRANES.—The Northern Engineering Works, Detroit, builder of cranes, cupolas, etc., have issued a 56-page, illustrated catalog, describing its extensive line of electric traveling cranes, hoists, overhead track and trolley systems, hand-power traveling cranes, jib, pillar, locomotive, gantry cranes, etc. Illustrations of installations of this equipment in various plants, including power houses, foundries, railroad shops, railroad and raw material storage yards, etc., are included.

General Industrial Notes

The B. B. Potter Foundry, Griffith, Ind., which has been operated for nearly 20 years, has been sold to the Duplex Mfg. Co., Chicago.

The Foundries Co., Orville, O., recently incorporated, has purchased the plant of the Postlewaite planing mill, and is fitting it up as a foundry.

The Orinda Stove & Mfg. Co., Quincy, Ill., has been incorporated with a capital of $50,000. The incorporators are C. H. Hurst, H. Lange and A. H. Stork.

The Seaside Foundry, Inc., Boston, has been incorporated with a capital of $5,000. The incorporators are G. F. Holmes, H. E. Bryant and M. T. Denham.

The Richmond Hill Iron Foundry Co., Richmond Hill, L. I., N. Y., will erect an addition to its gray iron foundry at a cost of $4,500.

The Warman Steel Casting Co., Los Angeles, Cal., has been incorporated with a capital of $50,000. The incorporators are G. B. and N. W. Warman.

The Foerderer Foundry Co., Indianapolis, has been incorporated with a capital stock of $10,000. The directors are Anthony, Louis and George Foerderer.

The National Foundry Co., Youngstown, O., recently organized, has leased the foundry formerly operated by the Youngstown Car Mfg. Co., and will make sash weights.

The Pacific Sash Weight Foundry, Los Angeles, Cal., has been incorporated with a capital of $25,000. The incorporators are E. C. Wilson, J. W. Begg and F. A. Buchanan.

The Springer Walker Foundry Co., Terre Haute, Ind., has been incorporated with a capital of $10,000. The incorporators are A. H. Springer, A. C. Whitaker and M. A. Whitaker.

The Nels Bracker Foundry & Machine Shop, Hutchinson, Minn., has been acquired by Thomas A. and Olaf Thomson, who will operate the plant under the firm name of Thomson Bros.

The R. E. Harryman Machine Co., Louisville, has been incorporated with a capital of $10,000 and will engage in jobbing foundry work. The incorporators are R. E. Harryman and F. A. Zazel.

The Queen Bee Stove Co., Joplin, Mo., has been incorporated with a capital of $50,000, and will engage in the manufacture of stoves. The incorporators are J. E. Walde, J. E. Crosbie and O. D. Hunt.

The Amherst Foundry Co., Ltd., incorporated in Nova Scotia, has been authorized to carry on business in Ontario on a capital not to exceed $40,000. The main office will be established in Toronto.

The plant of the Pennsylvania Malleable Co., McKees Rocks, Pa., has been absorbed by the Pressed Steel Car Co., Pittsburg, and will hereafter be known as the Pennsylvania Malleable department of this concern.

The Green Engineering Co., East Chicago, Ind., is adding new equipment, including a Whiting crane of 60-foot span, a No. 7 cupola with new charging floor, and a 42-inch magnet for carrying iron and steel.

The Wrought Iron Castings Co., New York City, has been incorporated with a capital of $50,000 and will engage in the manufacture of gray iron castings. The incorporators are A. A. Buchring, W. E. Volz and H. G. Kuerschner.

The Weaks Iron Works & Supply Co., Mon-

roe, La., manufacturer of machinery and mill supplies, whose consolidation with J. G. Saunders was recently noted in THE FOUNDRY, should have been credited with a paid-up capital stock of $40,000 instead of $10,000.

The firm name of the Rogers-Conklin Mfg. Co., Joplin, Mo., has been changed to the Rogers Foundry & Mfg. Co. The officers are as follows: J. A. Rogers, president and manager; Ellis Rogers, vice president, and Chas. B. Rogers, secretary and treasurer.

The Carthage Cornice Works, Carthage, Mo., which has in the past been operated on a partnership basis, has been incorporated as the Model Stove & Mfg. Co., with a capital of $15,000. The incorporators are L. M. Murphy, William Kitching and Victor Clinton.

The Chisholm & Moore Mfg. Co., Cleveland, will equip the portion of the plant of the Garry Iron & Steel Co., recently acquired, as an addition to its malleable iron foundry. A 15-ton malleable furnace will be erected and sand blast equipment will be installed.

The Economy Metals Co., Newark, N. J., has been incorporated with a capital stock of $10,000 and will manufacture flush valves and carry on a general plating and enameling business. The incorporators are Joseph W. Putnam, R. E. Fivey and Chas. W. Haberle.

The Canadian Steel Foundries, Ltd., has been incorporated with a capital of $5,000,000 with headquarters in Montreal. This concern is a merger of the Montreal Steel Co. and the Ontario Iron & Steel Co., of Welland. N. W. Curry, president of the Canadian Car & Foundry Co., is president of the merger.

The Central Foundry Co., Milwaukee, has doubled the capacity of its gray iron foundry. The company was organized six years ago to succeed the Burnham Foundry Co., and conducts a general jobbing business, but recently has begun to specialize in small gas engine cylinders. A. E. Martin is general manager and John Manning superintendent.

The Consolidated Castings Co., Syracuse, N. Y., was recently incorporated to combine the interests of the Turnbull-Smith Co., of Syracuse, and W. F. Green, of Mechanicsville, N. Y. The Green Co. has been manufacturing stove trimmings for over 20 years and the business will be continued at Mechanicsville with the addition of the sink bib and bath basin lines of the Turnbull-Smith Co. The Syracuse foundry of the latter concern will continue to make castings in brass, bronze and aluminum, but the main office of the consolidation will be at Mechanicsville.

NEW CONSTRUCTION.

The Carroll Foundry & Machine Co., Bucyrus, O., will erect a large addition to its plant.

The Favorite Stove & Range Co., Piqua, O., will erect an addition to its foundry, 110 x 300 feet.

The Charleroi Foundry & Machine Co., Charleroi, Pa., is erecting a two-story foundry and machine shop.

The Hassel Iron Works Co., Colorado Springs, Col., will extend its plant by the erection of a foundry.

The Jones & Hopkins Mfg. Co., Nashville, Tenn., stove founder, is erecting a $10,000 addition to its foundry and warehouse.

The Resnor Stove Co., Mercer, Pa., contemplates an extension to its foundry and is having plans prepared by W. E. Barr, Erie, Pa.

The Logansport Radiator Equipment Co., Logansport, Ind., is planning the erection of an addition to its factory, consisting of a foundry, core room and machine shop.

William E. Hill & Co., Kalamazoo, Mich., manufacturers of saw mill machinery, are erecting an extensive addition to their steel foundry. Steel is made by the converter process.

The Brown-Lewis Co., Walla Walla, Wash., manufacturer of agricultural machinery, announces that it will enlarge its plant and the plans include a foundry among other departments.

The Buckeye Steel Castings Co., Columbus, O., has purchased a tract of 85 acres at Indiana Harbor, Ind., on which will be built a large steel foundry to supply the requirements of its western trade.

The Taylor & Boggis Foundry Co., which recently sold its property on East Fifty-fifth street, Cleveland, to the Pennsylvania railroad, will soon erect a new gray iron shop on a site not yet selected.

The Anderson Tool Works, Anderson, Ind., has increased its manufacturing facilities by the addition of a gray iron foundry, which will be operated under the supervision of Russell Andrews, of Hamilton, O.

The American Bell & Foundry Co., Northville, Mich., has engaged F. S. Harman to prepare plans and to supervise the construction of its new foundry. The building will be of cement construction, 60 x 80 feet.

The Contractors' Casting & Machine Co., Buffalo, is increasing its foundry at Hertel avenue and the Erie railroad, by the erection of a building, 140 x 140 feet, with wings 40 x 50 feet and 15 x 50 feet, part of which will be used for casting cleaning purposes.

The Wentworth Institute, Brookline, Mass., is building as a part of its school equipment, a foundry in which practical instructions in all branches of the trade will be given. The shop will be well equipped throughout and castings will be produced the same as in a commercial plant.

The Lennox Furnace Co., Marshalltown, Ia., has secured an option on a tract of land on which it will erect a new factory, which will be known as the Quick Action Range Co., a separate corporation formed to take over the range manufacturing branch of the Lennox Co. The new company is capitalized at $225,000, of which $150,000 is common and $75,000, preferred stock.

George B. Limbert & Co., Chicago, are building a foundry for the manufacture of steam fitters' supplies at East Chicago, Ind. The building will be brick construction, 60 x 240 feet. The melting equipment will consist of two cupolas of 25 tons daily capacity, but at present only one will be installed. A pattern shop and storeroom will also be erected and other important extensions to the plant are contemplated.

AMONG THE BRASS FOUNDERS.

The Filer & Stowel Co., Milwaukee, Wis., will erect a small, detached building for use as a brass foundry.

The Isaac Joseph Co., Cincinnati, will erect a brass foundry on a 75-foot lot, recently acquired adjoining its plant.

The Gamon Meter Co., Newark, N. J., brass founder and manufacturer of water meters, will build a new plant, 30 x 208 feet, two stories high.

The Alliance Brass and Bronze Co., Alliance, O., has been incorporated with a capital of $15,000. C. W. Smith is one of the incorporators.

The Marsh Valve Co., Dunkirk, N. Y., has been incorporated with a capital of $250,000 and will engage in the manufacture of radiator valves, etc.

The Joan D'Arc Mfg. & Supply Co., St. Louis, will erect a plant for the manufacture of brass valves at Belleville, Ill. The building will be 80 x 585 feet.

The Youngstown Bronze & Iron Foundry Co., 548 Poland avenue, Youngstown, O., will increase the capacity of its plant by the erection of a large extension.

The Superior Bronze Co., Pittsburg, has been incorporated with a capital of $15,000. The incorporators are V. D. Sherlock, E. James, S. Hunt, W. Winner and A. J. Hunt.

The Lumen Bearing Co., Toronto Junction, Canada, will erect a fireproof addition to its plant. The new building will provide 1,100 square feet of additional floor space.

The Chicago, Milwaukee & St. Paul Railway Co. plans to erect a brass foundry in Kansas City, Mo., for the purpose of making car journal bearings and engine brasses for its own use.

The new brass foundry of the Bunting Brass & Bronze Co., Toledo, O., has recently been placed in operation. This shop has a capacity four times as great as that of the company's former foundry at Alliance, O.

The Wilsonia Brass & Bronze Works, New York, has been incorporated with a capital of $2,000 and will engage in the manufacture of brass and bronze castings. The incorporators are Morris Koppelman and David Wilson.

Shapiro & Aronson, Brooklyn, N. Y., brass founders and manufacturers of gas and electric fixtures, will erect a five-story building, 100 x 100 feet, of concrete construction. A large amount of new equipment will be purchased.

The Loeb Electro-chemical Co., New York City, manufacturer of platers' and polishers' supplies, recently organized by Walter R. Loeb, has removed from 20 John street to 467 Greenwich street, where larger quarters have been obtained.

The Franklin Brass Foundry Co., Reading, Pa., has been incorporated and will engage in the manufacture of brass and iron castings. The incorporators are: Frank A. Gring, F. W. Kancher, Oscar Rickenbach and Henry M. Koch.

C. J. Carlson, who has had 35 years' experience in brass foundry work, has established a plant at 103 Hart street, New Britain, Conn., for the manufacture of brass, bronze and other non-ferrous metal castings. The shop has a capacity of from 500 to 1,000 pounds per day.

The Dayton Bronze Bearing Co., Dayton, O., has been incorporated with a capital of $20,000. The new company will carry on the business formerly conducted by Israel Bros., iron and brass founders, and will make a specialty of steel car and railroad bearings. The incorporators are William B. Israel, J. M. Haas and Louis Elbers.

The Westminster Metal & Foundry Co., Westminster, Md., has been organized to engage in the manufacture of ingot brass and bronze and babbitt metals. This concern melts copper bearing materials in a small, water-jacketed blast furnace. The officers of the company are Oscar D. Gilbert, president; G. H. Atmacost, treasurer, and A. V. Moore, general manager.

The Fostoria Aluminum Mfg. Co., manufacturer of aluminum castings of all kinds, is erecting a new plant at Mishawaka, Ind., 95 x 65 feet. The office and pattern storage building will be 22 x 24 feet. The shop will be equipped with oil furnaces for melting brass and aluminum. Other equipment to be purchased will include a band saw for cutting off sprues, molding machines, etc. The machinery will be electrically operated.

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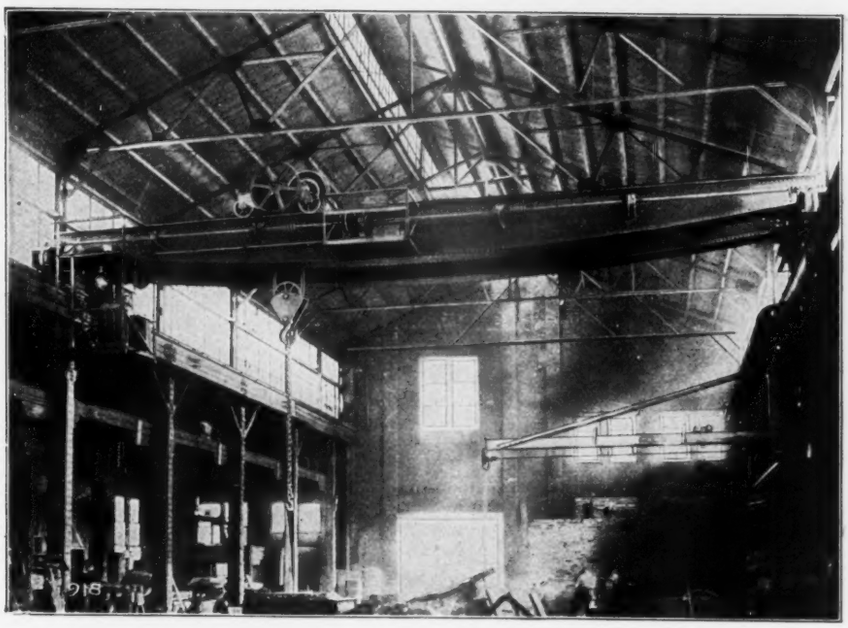

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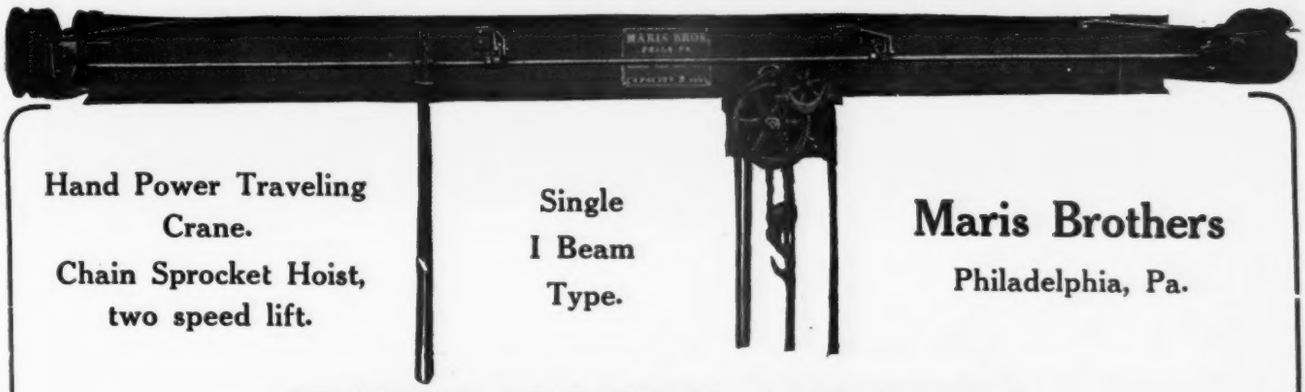

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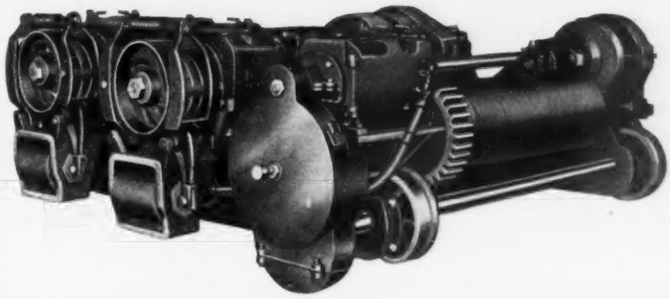

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Paxson Co., J. W., Philadelphia, Pa.
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A Steam Hydraulic Christmas Bouquet

FROM AWAY DOWN IN DIXIE

Clarksville, Tenn., U. S A., December 26th, 1910.
To the Adv. Man, Craig Ridgway & Son Co., Coatesville, Pa.

Dear Sir:—

I want to thank you for the Christmas Message in Iron Age. I don't know just how many years I have read your "Little Piece" as it appears each week in the Iron Age. Any way, long enough to find it a fixed need. Of course there is no business in this, and all I can do in return is to wish you well.

Long ago we "Hooked 'er to the Biler" and we have never had any trouble or bother of any sort to make us remember there is an elevator on the place. It seems to come up every morning like the sun, brand new, but it often stays on the job after the sun takes a rest behind the Western hills.

Here's to you and yours, may you live long and prosper and, like your Elevator, continue to take us up and away from troubles.

Sincerely yours, A. H. PATCH (Incorporated),
By Ben A. Patch, President.

Note that second paragraph of this letter, Mr. Foundryman.

He has run this Ridgway Steam Hydraulic Elevator every day for six years and it has never cost him a cent for anything.

Little things like this blowing in through the mails make life worth living.

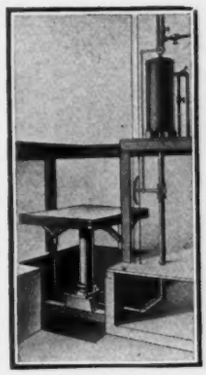
Old fellow, if you only knew this wonderful elevator like this party away down in old Tennessee, you would also

"Hook 'er to the Biler"

Craig Ridgway & Son Co.

COATESVILLE, PA.

Elevator Makers to Folks Who Know



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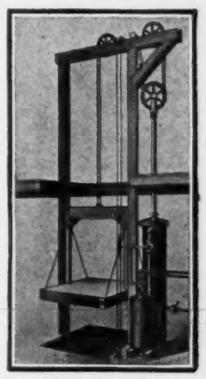

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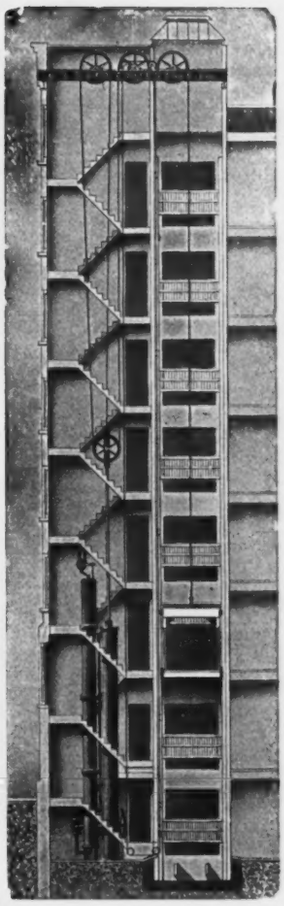

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Obermayer, S., Co., Cincinnati, O.
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Smith, J. D., Foundry Supply Co., Cleveland.
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Federal Fdy. Supply Co., Cleveland, O.
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Newport Sand Bank Co., Newport, Ky.
Obermayer, S., Co., Cincinnati, O.
Pangborn Company, Thomas W., New York.
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Whitehead Bros. Co.,
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Pangborn Company, Thomas W., New York.
Paxson Co., J. W., Philadelphia, Pa.
Smith, J. D., Foundry Supply Co., Cleveland.
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Tilghman-Brooksbank Sand Blast Co.,
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Tilghman-Brooksbank Sand Blast Co.,
Philadelphia, Pa.

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Obermayer, S., Co., Cincinnati, O.
Pangborn Company, Thomas W., New York.
Sand Mixing Machine Co., New York City.
Sellers, Wm., & Co., Inc., Philadelphia, Pa.
Standard Sand & Machine Co., Cleveland, O.

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Herman Pneumatic Mach. Co., Zelienople, Pa.
Hill & Griffith Co., Cincinnati, O.
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Obermayer, S., Co., Cincinnati, O.
Osborn Mfg. Co., Cleveland, O.
Pangborn Company, Thomas W., New York.
Paxson, J. W., Co., Philadelphia, Pa.
Standard Sand & Mach. Co., Cleveland, O.
Turner Machine Co., Philadelphia, Pa.

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(Window.)
Detroit Steel Products Co., Detroit, Mich.

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(Cold Cutting.)
Tabor Mfg. Co., Philadelphia, Pa.

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(Sand.)
Osborn Mfg. Co., Cleveland, O.
Standard Sand & Machine Co., Cleveland, O.

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Federal Fdy. Supply Co., Cleveland, O.
Hill & Griffith Co., Cincinnati, O.
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Providence, New York, Buffalo.

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Osborn Mfg. Co., Cleveland, O.
Paxson, J. W., Co., Philadelphia, Pa.
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American Vanadium Co., Pittsburg, Pa.

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Shuster, F. B., Co., New Haven, Conn.
Smith, J. D., Foundry Supply Co., Cleveland.
Turner Machine Co., Philadelphia, Pa.

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American Vanadium Co., Pittsburg, Pa.

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Dixon Crucible Co., Jos., Jersey City, N. J.
McCullough-Dalzell Crucible Co., Pittsburg, Pa.
Ross-Tacony Crucible Co., Philadelphia, Pa.

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Osborn Mfg. Co., Cleveland, O.

TESTING MACHINES.

Keep, W. J., Detroit, Mich.

TONGS.

(Crucible.)
Whiting Fdy. Equipment Co., Harvey, Ill.

TOOLS.

(Molders'.)
Dobson, William, Canastota, N. Y.
Federal Fdy. Supply Co., Cleveland, O.
Obermayer, S., Co., Cincinnati, O.
Osborn Mfg. Co., Cleveland, O.

TOOLS.

(Pneumatic.)
Ingersoll-Rand Co., New York, N. Y.
Pittsburg Pneumatic Tool Co., Canton, O.

TORCHES.

Hauck Mfg. Co., Brooklyn, N. Y.

TRACK.

(Industrial.)
Whiting Fdy. Equipment Co., Harvey, Ill.

TRAMRAIL SYSTEMS.

Northern Engineering Works, Detroit, Mich.
Randall Tramrail Co., Philadelphia, Pa.
Rockwell Furnace Co., New York.
Whiting Fdy. Equipment Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York.

TROLLEYS.

Northern Engineering Works, Detroit, Mich.
Whiting Fdy. Equipment Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York City.

TROLLEY SYSTEMS.

Smith, J. D., Foundry Supply Co., Cleveland.

TRUCKS.

Northern Engineering Works, Detroit, Mich.

TUMBLING BARRELS.

Betton, J. M., New York City.
McCormick, J. S., Co., Pittsburg, Pa.
Northern Engineering Works, Detroit, Mich.
Osborn Mfg. Co., Cleveland, O.
Paxson, J. W., Co., Philadelphia, Pa.
Smith, J. D., Foundry Supply Co., Cleveland.
Whiting Fdy. Equipment Co., Harvey, Ill.

TUMBLING MILLS.

Adams Co., Dubuque, Iowa.
Falls Rivet & Mch. Co., Cuyahoga Falls, O.
McCormick, J. S., Co., Pittsburg, Pa.
Sly, W. W., Mfg. Co., Cleveland, O.

TURNTABLES.

Northern Engineering Works, Detroit, Mich.
Whiting Fdy. Equipment Co., Harvey, Ill.

VANADIUM.

American Vanadium Co., Pittsburg, Pa.

VENTILATORS.

Royal Ventilator & Mfg. Co., Philadelphia, Pa.

VIBRATORS.

(Compressed Air.)
Osborn Mfg. Co., Cleveland, O.

WAX.

(Core.)
United Compound Co., Buffalo, N. Y.

WHEELBARROWS.

McCormick Co., J. S., Pittsburg, Pa.

WHEELS.

(Grinding.)
Carborundum Co., Niagara Falls, N. Y.

WHITE FINISH.

Osborn Mfg. Co., Cleveland, O.

WIRE CLEANING WHEELS.

Osborn Mfg. Co., Cleveland, O.

WIRE STRAIGHTENERS.

Blake, Geo. F., Mfg. Co., New York City.
Gregg Mfg. Co., Cleveland, O.
Pangborn Company, Thomas W., New York.
Shuster, F. B., Co., New Haven, Conn.

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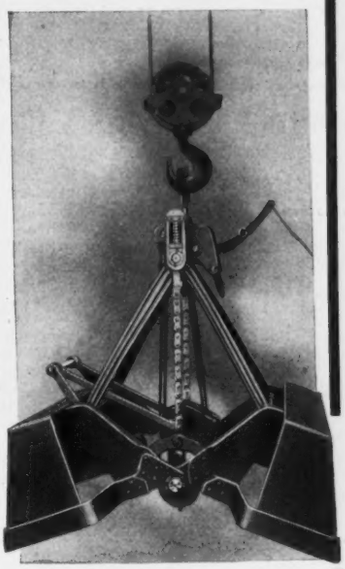
The "P. & H." single rope grab bucket can be operated from the hook of any crane. No special hoisting apparatus is necessary as it is manipulated entirely by the crane and the single tripping line.

It is hooked onto or off of the crane in an instant, as easily as the ordinary load and when bucket is not in use, the crane is always ready for other work.

This bucket is the outcome of considerable experimental work and is proving extremely efficient in actual service. Bucket illustrated weighs about 2 tons, empty, 4 tons with load, covers a floor space 6 x 6 feet when spread open and has a capacity of 1½ cubic yards. It works in considerable less head room than the ordinary type of grab bucket.



Bucket in position to gather load

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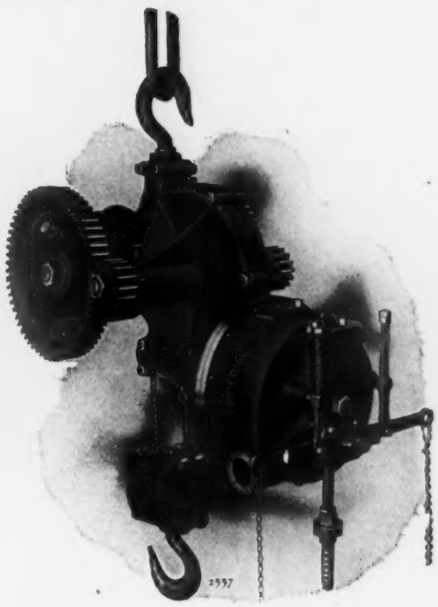

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One of these items is the cost of lifting, handling and transferring work and materials.

These things not only take time and money, but valuable floor-space as well, in many cases.

An "Imperial" Hoist lifts this share of the "burden," by cutting down time and cost on this class of work.

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Help Wanted

FOUNDRY FOREMAN WANTED TO take charge of foundry in furnace factory. Work about 30 molders. Must be thoroughly experienced in cupola and foundry practice. Reply stating age, whether married, single, experience and salary expected. Address Box 177, THE FOUNDRY, Cleveland, O.

A FOUNDRY FOREMAN WHO UNDERstands handling men to advantage. One who can turn out heavy and light architectural castings, plain and ornamental, at low cost. Address Box 194, THE FOUNDRY, Cleveland, O.

FOUNDRY MANAGER WANTED— Young man of ability and energy, one who knows how to do and sees that it is done. One having experience in the manufacture of heating apparatus preferred; state age, experience and salary expected. Address Box 193, THE FOUNDRY, Cleveland, O.

FOUNDRY SUPPLY SALESMAN WANTed to sell the best core oil in the country as a side line. Address Box 162, THE FOUNDRY, Cleveland, O.

FOUNDRY FOREMAN WANTED, CAPAble of taking entire charge of foundry melting about 25 to 30 tons per day. State age, experience and salary expected. Address Box 173, THE FOUNDRY, Cleveland, O.

ASSISTANT FOUNDRY FOREMAN wanted, experienced in cast iron, water and gas pipe fitting, flange pipe and miscellaneous castings. Must be familiar with molding machines. Address Box 155, THE FOUNDRY, Cleveland, O.

WANTED:—CAPABLE MAN TO SUPERintend mill grinding dry products, knowledge of manufacturing foundry facings desired; small investment will carry with it liberal salary and equal interest with owners. Address Box '09, THE FOUNDRY, Cleveland, O.

PATTERN MAKER WANTED—A FIRST-class man; also a first-class machine pattern maker. Address Box 167, THE FOUNDRY, Cleveland, O.

CORE MAKER WANTED—A FIRST-class, hustling, judicious, young or middle aged man to act as foreman in women's core-making department; he must be tactful and with good executive ability as well as being a thoroughly competent and practical core maker on small and medium size work. Write fully, stating experience, age, compensation expected, etc. Address Box 166, THE FOUNDRY, Cleveland, O.

FOREMAN COREMAKER — EXPERI-enced foreman for core department in general foundry employing about two hundred men. Good wages to right man; permanent employment with large. substantial concern. Address Box 144, THE FOUNDRY, Cleveland, O.

FIRST-CLASS FOREMAN PATTERN maker for factory in the state of Washington. One thoroughly familiar with patterns for harvesting machinery and general jobbing work required. A hustler and cost cutter. Address Box 170, THE FOUNDRY, Cleveland, O.

FOUNDRY FOREMAN, EXPERIENCED in grey iron, bench and floor work, also use of molding machines. State age, previous experience and salary expected. Give references. Open shop. Address Box 992, THE FOUNDRY, Cleveland, Ohio.

EXPERIENCED FOUNDRY FOREMAN wanted, for shop employing eight molders working piece work. Address Box 190, THE FOUNDRY, Cleveland, O.

WANTED:—FOUNDRY FOREMAN EX-perienced in cast iron water pipe fittings and flange pipe. Must be familiar with molding machines. Address Box 136, THE FOUNDRY, Cleveland, O.

MANAGER WANTED FOR A STEEL foundry. A man who is practical and has had previous successful experience in this capacity. Address Box 199, THE FOUNDRY, Cleveland, O.

Help Wanted

SUPERINTENDENT WANTED:—A MAN thoroughly up-to-date on modern malleable foundry practice to take entire charge of the manufacturing end of the business. One of sufficient executive ability to organize the entire manufacturing plant and able to produce castings at the lowest possible cost. State age, salary expected and reference. Address Box 201, THE FOUNDRY, Cleveland, O.

A STEEL CASTINGS SALESMAN WANT-ed. A practical man in all departments of the steel castings trade. Address Box 200, THE FOUNDRY, Cleveland, O.

EXPERIENCED ALUMINUM AND BRASS foundry foreman wanted, with about $1,000 to interest himself and take charge of an up-to-date foundry, with well established business, in the best town in northern Indiana. This is a first-class opportunity for the right man. Address Box 161, THE FOUNDRY, Cleveland, O.

WANTED—A GOOD COMPETENT STOVE pattern maker; must be up on white metal and aluminum work. A splendid opportunity to the right party with an up-to-date stove plant, located in the middle west. Give reference and salary wanted in application. Address "Middle West," THE FOUNDRY, Cleveland, O.

MACHINE MOLDER WANTED, WHO has worked piece work on molding machines. Must be thoroughly competent, steady, permanent employment, good wages paid. State number of flasks and sizes you consider a day's work. Married man preferred. Will also consider application for several first-class molders. Address Clark Bros. Co., Belmont, N. Y.

WANTED—A MANUFACTURING COM-pany running a foundry capacity 75 tons per day, desires a first-class chemist, college graduate, who is capable of taking charge of the mixtures, also a physical testing laboratory. State age, experience and college. Address Box 198, THE FOUNDRY, Cleveland, O.

WANTED—NON-UNION MOLDERS AND coremakers. Steady work for good men at good wages. Give reference. Address Box 145, THE FOUNDRY, Cleveland, O.

THREE FIRST CLASS LOCOMOTIVE cylinder molders wanted. Piece work; highest prices paid. Steady employment. Open shop. Address Box 914, THE FOUNDRY, Cleveland, O.

Positions Wanted

POSITION WANTED IN CRUCIBLE steel foundry, capable of taking entire charge. Molding, mixing and melting, 15 years experience. Best of references. Address Box 156, THE FOUNDRY, Cleveland, O.

AS FOUNDRY FOREMAN WITH SOME company who want to lessen their cost of molding. Six years experience as assistant and one as foreman. Wide experience on match plate and molding machines. Address Box 191, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS FOUNDRY foreman, by a middle aged married man. Railroad and a jobbing shop preferred. A hustler and can give the best of reference. Address Box 171, THE FOUNDRY, Cleveland, O.

POSITION OF FOREMAN OF GRAY iron foundry. Up-to-date in foundry practice, married, strictly temperate, 30 years experience. Address Box 123, THE FOUNDRY, Cleveland, O.

WOULD LIKE TO CORRESPOND WITH firm looking for general superintendent of foundry. Have held present position as general superintendent for five years, with company manufacturing machinery and special piping. Practical experience in machine shop, pattern making, up-to-date rigging and operating jolt machines and melting iron by analysis. Address Box 192, THE FOUNDRY, Cleveland, O.

Positions Wanted.

BY GENERAL FOUNDRY FOREMAN over 12 years experience in steel foundry making castings from 50 pounds to 120 tons. Can give best of references. Address Box 178, THE FOUNDRY, Cleveland, O.

POSITION WANTED WITH MALLEABLE iron company where the services of a practical superintendent is desired. Have had twenty (20) years of experience. Address Box 181, THE FOUNDRY, Cleveland, O.

POSITION WANTED BY PRACTICAL foundry foreman, having eleven (11) years of experience. Any firm in need of a first-class man should address Box 165, THE FOUNDRY, Cleveland, O.

POSITION AS FOUNDRY FOREMAN— Twenty-six years experience on bath tubs, sinks, lavatories, pipe fittings, etc.; 5 years as foreman. Address Box 164, THE FOUNDRY, Cleveland, O.

PRACTICAL FOUNDRY FOREMAN OPEN for engagement, or as assistant in large plant, best of references. Address Box 196, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS FOUNDRY foreman in a small shop by a young foundryman. Best of references. New England preferred. Address Box 195, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS SUPERINTEN-dent or foreman, by a thoroughly reliable and temperate man of 38 years, 19 years of good practical experience in light and heavy machinery and railroad castings. Can handle men to the greatest advantage to firm. Can furnish A-1 references. Address Box 168, THE FOUNDRY, Cleveland, O.

POSITION AS GENERAL FOREMAN IN foundry making light castings. Long experience as a practical man on stoves, gas ranges, heaters and light work generally. Floor and bench, gated work and match plates. Expert on molding machines and match plate equipment. Up-to-date in cupola practice. I can handle men to good advantage and produce results. Open shop preferred. A-1 references furnished. Address "Result-Getter," THE FOUNDRY, Cleveland, O.

POSITION WANTED BY FIRST CLASS foundry foreman. Accustomed to all kinds of machinery, heavy mining machinery a specialty. Will take a hand on the floor if necessary. Address Box 57, THE FOUNDRY, Cleveland, O.

THE SERVICES OF A FOUNDRY SU-perintendent or general manager of merit, 38 years old, married, with 10 years experience, is open for engagement. Applicant is sufficiently pliable to adapt himself to extraordinary conditions and possesses enough energy and ability to fill the most exacting requirements. For further information address Box 183, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS FOREMAN patternmaker by a man of first-class ability and experience in all kinds of gas, steam engine and general work. Best of references. Open shop preferred. Address Box 179, THE FOUNDRY, Cleveland, O.

PRACTICAL FOREMAN, INVENTIVE and up-to-date on all foundry problems. desires to make a change, prefer the south or southwest. Address Box 114, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS ENGINEER OR master mechanic in cast iron pipe foundry. Experienced in the manufacture of pipe and fittings, designing of machinery and fixtures. Address "N. W.," 6th and Washington Sts., Camden, N. J.

POSITION WANTED BY FIRST CLASS foundry foreman of recognized ability. 40 years old, 24 years experience, 9 as foreman. First class references. Address Box 140, THE FOUNDRY, Cleveland, O.